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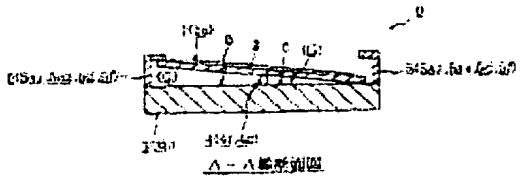
(54) OPTICAL DEFLECTION METHOD AND DEVICE, METHOD FOR MANUFACTURING OPTICAL DEFLECTING DEVICE, OPTICAL INFORMATION PROCESSOR PROVIDED WITH THE OPTICAL DEFLECTING DEVICE, IMAGE FORMING DEVICE IMAGE PROJECTING AND DISPLAY DEVICE AND OPTICAL TRANSMITTING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an optical deflecting device of which the structure and control for performing optical deflection in a uniaxial or biaxial direction are simple and easy, in which stable operation and fast response are assured, the wavelength of incident light is not restricted, deterioration in mechanical strength is small, driving voltage is low, miniaturization and integration are possible at a low cost, and use environment is not restricted, an optical deflecting method, a method for manufacturing the optical deflecting device, an optical information processor provided with the optical deflecting device, an image forming device, an image projecting and display device and an optical transmitting device.
SOLUTION: A plate-shaped member 2 is arranged in a gap (G) formed between a supporting member 4 on a substrate 3 and a bamboo hat-shaped member 5 without being fixed onto the substrate 3 so that the plate-shaped member 2 is freely displaceable. Electric potential is given to an electrode 6 arranged opposite to the plate-shaped member 2 around the supporting member 4 on the substrate 3. A reflecting means 1 on the plate-shaped member 2 mounted with a tilt on the supporting member 4 changes the reflection direction of the incident light to perform optical deflection.



CLAIMS

[Claim(s)]
[Claim 1]
In an optical deflection method of changing a reflecting direction of incident light in one axis or the biaxial direction, and performing an optical deflection, A plate shape component of plate shape formed with a thin film which combines with the surface a reflective means to reflect incident light, and constitutes it, Displacement arranges in the state of freedom in a void formed between bamboo hat-shaped bamboo hat shape members a fulcrum member top on the above-mentioned substrate without fixing on a substrate, An optical deflection method giving potential to an electrode which countered the circumference of the above-mentioned fulcrum member on the above-mentioned substrate with the above-mentioned plate shape component, and has been arranged, changing a reflecting direction of incident light by the above-mentioned reflective means on the above-mentioned plate shape component inclined and laid on the above-mentioned fulcrum member, and performing an optical deflection.
[Claim 2]
An optical deflection method giving potential which is different in two or more electrodes of each which an electrode countered the circumference of a fulcrum member on a substrate with a plate shape component, and were arranged in an optical deflection method according to claim 1, and performing an optical deflection.
[Claim 3]
Potential which is different in an electrode is given in an optical deflection method according to claim 1 or 2, An optical deflection method contacting a slant face on a substrate in a plate shape component of plate shape formed with a thin film which combines a reflective means with the surface and constitutes it, specifying and changing a reflecting direction of incident light in a position which contacts, and performing an optical deflection.
[Claim 4]
Optical deflection equipment which changes a reflecting direction of incident light in one axis or the biaxial direction, and performs an optical deflection, comprising:
A reflective means to reflect incident light.
A plate shape component of plate shape formed with a thin film which combines the above-mentioned reflective means with the surface, and constitutes it.
A substrate laid without fixing the above-mentioned plate shape component.
An electrode which countered the circumference of a fulcrum member used as a fulcrum at the time of displacement of the inclining above-mentioned plate shape component on the above-mentioned substrate, a bamboo hat shape member of bamboo hat form which forms a void where displacement is arranged in the state of freedom in the above-mentioned plate shape component on the above-mentioned fulcrum member, and the above-mentioned fulcrum member on the above-mentioned substrate with a rear face of the above-mentioned plate shape component, and has been arranged.

[Claim 5]
Optical deflection equipment monotonous [of a reflective means] and formed in the optical deflection equipment according to claim 4.
[Claim 6]
Optical deflection equipment, wherein a reflective means is formed with an aluminum system metal membrane in the optical deflection equipment according to claim 4 or 5.
[Claim 7]
Optical deflection equipment, wherein a plate shape component becomes the face shape of a part which touches a fulcrum member from a curved shape section of curved shape in the optical deflection equipment according to claim 4, 5, or 6.
[Claim 8]
Optical deflection equipment with which a plate shape component is characterized by an outside being a circle configuration in the optical deflection equipment according to claim 4, 5, 6, or 7.
[Claim 9]
Optical deflection equipment, wherein a plate shape component consists of silicon nitride films in the optical deflection equipment according to claim 4, 5, 6, 7, or 8.
[Claim 10]
Optical deflection equipment, wherein a reflective means or a plate shape component has a conductive area which has conductivity in the optical deflection equipment according to claim 4, 5, 6, 7, 8, or 9 and the above-mentioned conductive area counters with an electrode.
[Claim 11]
Optical deflection equipment, wherein a substrate consists of a hollow-shaped hollow form part in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, or 10.
[Claim 12]
Optical deflection equipment, wherein a substrate consists of a silicon substrate which has a plane direction (100) in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, 10, or 11.
[Claim 13]
Optical deflection equipment with which a fulcrum member is characterized by face shape of a part which touches a plate shape component being a circular shaped part in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, 10, 11, or 12.

[Claim 14]
Optical deflection equipment characterized by a fulcrum member being a conical shape part which touches a plate shape component at a point in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, 10, 11, or 12.
[Claim 15]
Optical deflection equipment with which a fulcrum member is characterized by a field which touches a plate shape component being a rectangular rectangular form part in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, 10, 11, or 12.
[Claim 16]
Optical deflection equipment characterized by a fulcrum member being a ridge form part which consists of form of a ridge which touches a plate shape component by a line in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, 10, 11, or 12.
[Claim 17]
Optical deflection equipment, wherein a fulcrum member has a slant face which touches a plate shape component in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, 10, 11, or 12.
[Claim 18]
Optical deflection equipment, wherein a fulcrum member consists of a silicon oxide film or a silicon nitride film in the optical deflection equipment according to any one of claims 4 to 17.
[Claim 19]
Optical deflection equipment, wherein a bamboo hat shape member vacated a predetermined interval and has arranged two or more bamboo hat shape members of each corresponding to a periphery of a plate shape component in the optical deflection equipment according to any one of claims 4 to 18.
[Claim 20]
Optical deflection equipment having arranged a bamboo hat shape member to all the fields corresponding to a periphery of a plate shape component in the optical deflection equipment according to any one of claims 4 to 18.
[Claim 21]
Optical deflection equipment, wherein a bamboo hat shape member consists of an insulator layer which has insulation in the optical deflection equipment according to any one of claims 4 to 20.
[Claim 22]
Optical deflection equipment, wherein a bamboo hat shape member consists of a translucency film which has translucency to an incoming beam in the optical deflection equipment according to any one of claims 4 to 21.
[Claim 23]
Optical deflection equipment, wherein a bamboo hat shape member consists of silicon oxide films in the optical deflection equipment according to any one of claims 4 to 22.
[Claim 24]
Optical deflection equipment, wherein a bamboo hat shape member consists of a shading film which has a light sheilding to an incoming beam in the optical deflection equipment according to any one of claims 4 to 23.
[Claim 25]
Optical deflection equipment, wherein a bamboo hat shape member consists of chromium oxide films in the optical deflection equipment according to any one of claims 4 to 24.
[Claim 26]
Optical deflection equipment, wherein an electrode consisted of two or more electrodes of each and a plate shape component has floated electrically in the optical deflection equipment according to any one of claims 4 to 25.
[Claim 27]
Optical deflection equipment having arranged two or more electrodes of each in the optical deflection equipment according to claim 26 on a rear face of a plate shape component, and a slant face which countered.
[Claim 28]
Optical deflection equipment forming a one-dimensional optical deflection array arranged to one-dimensional array form in two or more optical deflection equipment according to any one of claims 4 to 27.
[Claim 29]
Optical deflection equipment forming a two-dimensional optical deflection array arranged to two-dimensional array form in two or more optical deflection equipment according to any one of claims 4 to 28.
[Claim 30]
In a manufacturing method of the optical deflection equipment according to any one of claims 4 to 29 which changes a reflecting direction of incident light in one axis or the biaxial direction, and performs an optical deflection, A plate shape component of plate shape formed with a thin film which combines the above-mentioned reflective means with the surface, and constitutes it via the 1st sacrifice layer that formed a fulcrum member and an electrode, and deposited and carried out flattening on a substrate is formed, A manufacturing method of optical deflection equipment characterized by removing the 1st sacrifice layer of the above, and the 2nd sacrifice layer of the above after patternizing a bamboo hat shape member to a position which patternized the 2nd deposited sacrifice layer.
[Claim 31]
In a manufacturing method of the optical deflection equipment according to claim 30, a fulcrum member and an electrode are formed on a substrate, A plate shape component which consists of a curved shape section of curved shape formed with a thin film which combines the above-mentioned reflective means with the surface, and constitutes it via the 3rd sacrifice layer that the above-mentioned fulcrum member was made to project and was deposited, was deposited on the 1st sacrifice layer that carried out flattening in piles, and carried out flattening to it is formed, A manufacturing method of optical deflection equipment characterized by removing the 1st sacrifice layer of the above, the 2nd sacrifice layer of the above, and the 3rd sacrifice layer of the above after patternizing a bamboo hat shape member to a position which patternized the 2nd deposited sacrifice layer.
[Claim 32]
A fulcrum member and an electrode which become depressed on a substrate and become a form part and the above-mentioned hollow form circles from a slant face in a manufacturing method of the optical deflection equipment according to claim 30 are formed, A plate shape component of plate shape formed with a thin film which accumulates, combines the above-mentioned reflective means with the surface, and constitutes it via the 1st sacrifice layer that carried out flattening is formed, A manufacturing method of optical deflection equipment characterized by removing the 1st sacrifice layer of the above, and the 2nd sacrifice layer after patternizing a bamboo hat shape member to a position which patternized the 2nd deposited sacrifice layer.

[Claim 33]
A manufacturing method of optical deflection equipment removing a sacrifice layer from a predetermined interval which has vacated and arranged between each bamboo hat shape member of plurality of a bamboo hat shape member in a manufacturing method of the optical deflection equipment according to claim 30, 31, or 32.
[Claim 34]
In an optical information processing device which processes light information using optical deflection equipment which changes a reflecting direction of incident light in one axis or the biaxial direction, and performs an optical deflection, An optical information processing device becoming any 1 clause of two or more above-mentioned Claims 4-29 from an independent drive means to drive respectively optical deflection equipment and two or more above-mentioned optical deflection equipment of a description independently.
[Claim 35]
In an image forming device which performs optical writing by an electrophotography process and forms a picture, A latent image formation means which becomes any 1 clause of the above-mentioned Claims 4-29 which perform optical writing and form a latent image on picture support which is held rotatable and supports a formed image, and described image support from optical deflection equipment of a description, A developing means which develops a latent image formed by the above-mentioned optical deflection equipment of the above-mentioned latent image formation means, and forms a toner image, and a transfer means which transfers a toner image formed by the above-mentioned developing means to a transferred object.
[Claim 36]
An image projection display device which projects and displays a picture, comprising:
An optical switch means which consists of the optical deflection equipment according to any one of claims 4 to 29 which changes a reflecting direction of incident light of image projection data, performs an optical deflection, and projects and displays a picture.
A projection screen which displays a picture which the above-mentioned optical switch means projects.

[Claim 37]
An optical transmission device which determines an optical path of a lightwave signal, and outputs and transmits it, comprising:
A lightwave signal input means which inputs a lightwave signal.
An optical switch means which consists of the optical deflection equipment according to any one of claims 4 to 29 which changes a reflecting direction of incident light of a lightwave signal from the above-mentioned lightwave signal input means in one axis or the biaxial direction, performs an optical deflection, and determines an optical path of each lightwave signal.
A lightwave signal output means which outputs a lightwave signal from the above-mentioned optical switch means.

[Claim 38]
An optical transmission device, wherein an optical switch means consists of two or more steps of pieces of optical deflection equipment in the optical deflection equipment according to claim 37.
[Claim 39]
Optical deflection equipment characterized by said fulcrum member being 4 pyramid form of contacting at said plate shape component and a point in optical deflection equipment of any one description of the Claims 4-12.
[Claim 40]
Optical deflection equipment characterized by a size of the bottom of a fulcrum member of said 4 pyramid form being almost equal to a size of said plate shape component in the optical deflection equipment according to claim 39.
[Claim 41]
Optical deflection equipment determining a reflecting direction of an incoming beam by contacting by said substrate, point, or a line in optical deflection equipment of any one description of the Claims 4-16 when said plate shape component is displaced with electrostatic attraction.
[Claim 42]
In optical deflection equipment which changes a reflecting direction of incident light into two or more shaft orientations, and performs an optical deflection, A substrate laid without fixing a plate shape component and the above-mentioned plate shape component of plate shape which has a reflex function which reflects incident light, A fulcrum member used as a fulcrum at the time of displacement of the inclining above-mentioned plate shape component on the above-mentioned substrate, Optical deflection equipment consisting of an electrode which countered the circumference of a bamboo hat shape member of bamboo hat form which forms a void where displacement is arranged in the state of freedom in the above-mentioned plate shape component on the above-mentioned fulcrum member, and the above-mentioned fulcrum member on the above-mentioned substrate with a rear face of the above-mentioned plate shape component, and has been arranged.
[Claim 43]
Optical deflection equipment, wherein said plate shape component is formed with a monolayer thin film in the optical deflection equipment according to claim 42.
[Claim 44]
Optical deflection equipment monotonous [of a reflective means] and formed in the optical deflection equipment according to claim 42 or 43.
[Claim 45]
Optical deflection equipment, wherein a reflective means is formed with an aluminum system metal membrane in optical deflection equipment of any one description of the Claims 42-44.
[Claim 46]
Optical deflection equipment, wherein a plate shape component becomes the face shape of a part which touches a fulcrum member from a curved shape section of curved shape in optical deflection equipment of any one description of the Claims 42-45.

[Claim 47]
optical deflection equipment with which it resembles any one of the Claims 42-46, and a plate shape component is characterized by an outside being a circle configuration in optical deflection equipment of a description.
[Claim 48]
optical deflection equipment which resembles any one of the Claims 42-47, and is characterized by a reflective means or a plate shape component having a conductive area which has conductivity, and the above-mentioned conductive area countering with an

electrode in optical deflection equipment of a description.
[Claim 49]
optical deflection equipment, wherein it resembles any one of the Claims 42-48 and a substrate consists of a hollow-shaped hollow form part in optical deflection equipment of a description.
[Claim 50]
optical deflection equipment, wherein it resembles any one of the Claims 42-49 and a substrate consists of a silicon substrate which has a plane direction (100) in optical deflection equipment of a description.
[Claim 51]
optical deflection equipment with which it resembles any one of the Claims 42-50, and face shape of a part where a fulcrum member touches a plate shape component is characterized by being a circular shaped part in optical deflection equipment of a description.
[Claim 52]
optical deflection equipment which resembles any one of the Claims 42-50, and is characterized by a fulcrum member being a conical shape part which touches a plate shape component at a point in optical deflection equipment of a description.
[Claim 53]
optical deflection equipment with which it resembles any one of the Claims 42-50, and a field where a fulcrum member touches a plate shape component is characterized by being a rectangular rectangular form part in optical deflection equipment of a description.
[Claim 54]
Optical deflection equipment characterized by said fulcrum member being 4 pyramid form of contacting at said plate-like member and a point in optical deflection equipment of any one description of the Claims 42-50.
[Claim 55]
Optical deflection equipment characterized by a size of the bottom of a fulcrum member of said 4 pyramid form being almost equal to a size of said plate-like member in the optical deflection equipment according to claim 54.
[Claim 56]
Optical deflection equipment determining a reflecting direction of an incoming beam by contacting by said substrate, point, or a line in optical deflection equipment of any one description of the Claims 42-53 when said plate-like member is displaced with electrostatic attraction.
[Claim 57]
optical deflection equipment, wherein it resembles any one of the Claims 42-56 and a fulcrum member has a slant face which touches a plate shape component in optical deflection equipment of a description.
[Claim 58]
Optical deflection equipment with which light flux which enters into this light reflex field by being displaced with electrostatic attraction characterized by comprising the following according to potential given to a component which has a light reflex field changes a reflecting direction, and is deflected.
A substrate.
Two or more regulating members.
A fulcrum member.
It has a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, and are provided in two or more ends of said substrate, respectively, and said fulcrum member is conductivity.

[Claim 59]
Optical deflection equipment characterized by the upper surface whole region of said plate-like member being said light reflex field in the optical deflection equipment according to claim 59.
[Claim 60]
Optical deflection equipment, wherein said plate-like member is constituted by lamination with a dielectric layer which consists of a component which has a dielectric, and said conductor layer in the optical deflection equipment according to claim 58 or 59.
[Claim 61]
Optical deflection equipment characterized by specific inductive capacity of said dielectric layer being three or more in the optical deflection equipment according to claim 60.
[Claim 62]
Optical deflection equipment, wherein said dielectric layer of said plate-like member is constituted with a silicon nitride film in the optical deflection equipment according to claim 60 or 61.
[Claim 63]
Optical deflection equipment, wherein two or more electrodes are formed in optical deflection equipment of any one description of the Claims 58-62 on said substrate which counters the rear-face side of said plate-like member and this electrode is electrically separated from said crowning of said fulcrum member.
[Claim 64]
Optical deflection equipment, wherein said at least a part of conductor layer of said plate-like member has countered with said electrode in the optical deflection equipment according to claim 63.
[Claim 65]
Optical deflection equipment which said plate-like member and said fulcrum member have touched at a point mostly in optical deflection equipment of any one description of the Claims 58-64, and is characterized by said fulcrum member being a cone.
[Claim 66]
Optical deflection equipment being a polygonal-pyramid object in which said plate-like member and said fulcrum member have touched at a point mostly, and said fulcrum member has two or more slant faces in optical deflection equipment of any one description of the Claims 58-64.
[Claim 67]
Optical deflection equipment being a columnar body in which said plate-like member and said fulcrum member have touched by a line mostly, and said fulcrum member has a slant face in optical deflection equipment of any one description of the Claims 58-64, and a crowning has ** in which said plate-like member and line contact are possible.
[Claim 68]

Optical deflection equipment, wherein said slant face carries out two or more owners of the electrode for [of said plate-like member] being mostly formed corresponding to the whole region and making electrostatic attraction act on said slant face in the optical deflection equipment according to claim 66 or 67.
[Claim 69]
Optical deflection equipment, wherein the direction of an optical deflection is specified by displacing said plate-like member with electrostatic attraction from said slant face, and contacting to said slant face in the optical deflection equipment according to claim 68.
[Claim 70]
Optical deflection equipment, wherein the direction of an optical deflection is specified by forming two or more convex parts on said slant face, displacing said plate-like member with electrostatic attraction from said slant face in the optical deflection equipment according to claim 68, and contacting to said convex part.
[Claim 71]
Optical deflection equipment which carries out the feature of atmosphere near said plate-like member being a vacuum mostly in optical deflection equipment of any one description of the Claims 68-70.
[Claim 72]
Optical deflection equipment which carries out the feature of atmosphere near said plate-like member being the atmosphere of an inertness gas in optical deflection equipment of any one description of the Claims 68-70.
[Claim 73]
In optical deflection equipment of any one description of the Claims 63-72, Optical deflection equipment making equal to the maximum of potential and one value of the minimums which are given to said two or more electrodes potential which gives respectively arbitrary potential so that maximum potential difference may become said two or more electrodes beyond a specified value, and is given to said crowning.
[Claim 74]
In optical deflection equipment of any one description of the Claims 63-72, About a straight line which passes along said crowning which serves as an axis of displacement of said plate-like member among said two or more electrodes, Optical deflection equipment making potential which gives respectively arbitrary potential so that maximum potential difference may become in an electrode which exists in the same side beyond a specified value, and is given to said crowning into the maximum of potential and an abbreviated mean value of the minimum which are given to said two or more electrodes.
[Claim 75]
Optical deflection equipment characterized by said conductor layer being an aluminum system metal membrane in optical deflection equipment of any one description of the Claims 58-74.
[Claim 76]
Optical deflection equipment, wherein said conductor layer serves as said light reflex field in the optical deflection equipment according to claim 75.
[Claim 77]
An optical deflection array having arranged optical deflection equipment of any one description of the Claims 58-76 to one dimension or two-dimensional array form on plurality and arbitrary substrates.
[Claim 78]
An image projection display device using optical deflection equipment or the optical deflection array according to claim 77 of any one description of the Claims 58-76 as an optical switch means which changes a reflecting direction of incident light according to image data, and projecting a picture by said image data on a screen.
[Claim 79]
An image projection display device, wherein a normal line direction of a light reflection surface in case said plate-like member of said optical deflection equipment is in a center valve position arranges in the image projection display device according to claim 78 so that it may become in the direction mostly with the operation direction of gravity.
[Claim 80]
An image forming device using the optical deflection array according to claim 77 as a line exposure type latent image formation means.
[Claim 81]
An image forming device, wherein a normal line direction of a light reflection surface in.case said plate-like member of said optical deflection equipment is in a center valve position arranges in the image forming device according to claim 80 so that it may become in the direction mostly with the operation direction of gravity.
[Claim 82]
An optical transmission device characterized by changing transmission of light information between one input/output port and arbitrary ports in two or more input/output port using optical deflection equipment of any one description of the Claims 58-76 as an optical switch means.
[Claim 83]
An optical transmission device characterized by changing transmission of light information, respectively between arbitrary ports in two or more input/output port of one input output section, and arbitrary ports in input/output port of plurality of an input output section of another side using the optical deflection array according to claim 77 as an optical switch means.
[Claim 84]
An optical transmission device, wherein a normal line direction of a light reflection surface in case said plate-like member of said optical deflection equipment is in a center valve position arranges in the optical transmission device according to claim 83 so that it may become in the direction mostly with the operation direction of gravity.
[Claim 85]
A process which patternizes a process of forming said fulcrum member at least, and a component which has the conductivity of two or more electrodes and said fulcrum member at an arbitrary substrate top, and is formed, A process of patternizing said plate-like member which serves as deposition and a process which carries out flattening from at least one layer in the 1st sacrifice layer, A process of depositing the 2nd sacrifice layer, and a process of patternizing the 1st sacrifice layer and 2nd sacrifice layer, A manufacturing method of optical deflection equipment of any one description of the Claims 58-76 having a process of patternizing said regulating member in arbitrary parts of the 1st and 2nd patternized this sacrifice layers, and the process of removing the 1st and 2nd this patternized sacrifice layers by etching.

[Claim 86]
A manufacturing method of the optical deflection array according to claim 77 characterized by comprising the following.
A process of sticking two or more divisions one dimension or in the shape of two dimensions, forming them, and forming said fulcrum member at least for every division on arbitrary substrates.
A process of patternizing and forming a component which has the conductivity of two or more electrodes and said fulcrum member.
They are deposition and a process which carries out flattening about the 1st sacrifice layer.
A process of patternizing said plate-like member which consists of at least one layer, and a process of depositing the 2nd sacrifice layer, A process of patternizing the 1st sacrifice layer and 2nd sacrifice layer, a process of patternizing said regulating member in arbitrary parts of the 1st and 2nd this patternized sacrifice layers, and a process of removing the 1st and 2nd this patternized sacrifice layers by etching.

[Claim 87]
A manufacturing method of the optical deflection equipment according to claim 110 characterized by comprising the following.
A process which makes a thin film deposit on two or more electrodes at least.
A process of patternizing this thin film and forming a convex part.

[Claim 88]
Optical deflection equipment with which light flux which enters into this light reflex field by being displaced with electrostatic attraction characterized by comprising the following according to potential given to a component which has a light reflex field changes a reflecting direction, and is deflected.
A substrate.
Two or more regulating members.
A fulcrum member.
It has a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, and are provided in two or more ends of said substrate, respectively, and said fulcrum member is conductivity.

[Claim 89]
Optical deflection equipment with which light flux which enters into this light reflex field by being displaced with electrostatic attraction characterized by comprising the following according to potential given to a component which has a light reflex field changes a reflecting direction, and is deflected.
A substrate.
Two or more regulating members.
A fulcrum member.
It has a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, and are provided in two or more ends of said substrate, respectively, and said fulcrum member is conductivity.

[Claim 90]
Optical deflection equipment with which light flux which enters into this light reflex field by being displaced with electrostatic attraction characterized by comprising the following according to potential given to a component which has a light reflex field changes a reflecting direction, and is deflected.
A substrate.
Two or more regulating members.
A fulcrum member.
It has a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, and are provided in two or more ends of said substrate, respectively, and said fulcrum member is conductivity.

[Claim 91]
Optical deflection equipment with which light flux which enters into this light reflex field by being displaced with electrostatic attraction characterized by comprising the following according to potential given to a component which has a light reflex field changes a reflecting direction, and is deflected.
A substrate.
Two or more regulating members.
A fulcrum member.
It has a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, and are provided in two or more ends of said substrate, respectively, and said fulcrum member is conductivity.

[Claim 92]
Optical deflection equipment with which light flux which enters into this light reflex field by being displaced with electrostatic attraction characterized by comprising the following according to potential given to a component which has a light reflex field changes a reflecting direction, and is deflected.
A substrate.
Two or more regulating members.
A fulcrum member.
It has a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, and are provided in two or more ends of said substrate, respectively, and said fulcrum member is conductivity.

[Claim 93]
By being displaced with electrostatic attraction according to potential given to a component which has a light reflex field, In optical deflection equipment with which light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate,

respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and a point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in space between said substrate, said fulcrum member, and said stopper, Potential of said plate-like member was given by contact with said fulcrum member, and said plate-like member and said fulcrum member have touched at a point mostly, and -- said fulcrum member is a polygonal-pyramid object which has two or more slant faces -- said slant face -- said plate-like member -- it being mostly formed corresponding to the whole region, and, On said slant face, carry out two or more owners of the electrode for making electrostatic attraction act, two or more convex parts are formed on said slant face, and said plate-like member is displaced with electrostatic attraction from said slant face, Optical deflection equipment, wherein the direction of an optical deflection is specified and said convex part is arranged by band-like [two or more] on an electrode by contacting to said convex part.

[Claim 94]

Optical deflection equipment with which light flux which enters into this light reflex field by being displaced with electrostatic attraction characterized by comprising the following according to potential given to a component which has a light reflex field changes a reflecting direction, and is deflected.

A substrate.

Two or more regulating members.

A fulcrum member.

It has a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, and are provided in two or more ends of said substrate, respectively, and said fulcrum member is conductivity.

[Claim 95]

By being displaced with electrostatic attraction according to potential given to a component which has a light reflex field, In optical deflection equipment with which light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate, respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and a point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in space between said substrate, said fulcrum member, and said stopper, Potential of said plate-like member was given by contact with said fulcrum member, and said plate-like member and said fulcrum member have touched by a line mostly, And said fulcrum member has a slant face, crownings are said plate-like member and a columnar body which has ** in which line contact is possible, said slant face carries out two or more owners of the electrode for being mostly formed corresponding to the whole region and making electrostatic attraction act on said slant face of said plate-like member, and two or more convex parts are formed on said slant face, Optical deflection equipment, wherein said plate-like member is displaced with electrostatic attraction from said slant face, the direction of an optical deflection is prescribed by by contacting to said convex part and said convex part is arranged by band-like [two or more] on an electrode.

[Claim 96]

By being displaced with electrostatic attraction according to potential given to a component which has a light reflex field, In optical deflection equipment with which light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate, respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and a point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in space between said substrate, said fulcrum member, and said stopper, Potential of said plate-like member was given by contact with said fulcrum member, and said plate-like member and said fulcrum member have touched by a line mostly, And said fulcrum member has a slant face, crownings are said plate-like member and a columnar body which has ** in which line contact is possible, said slant face carries out two or more owners of the electrode for being mostly formed corresponding to the whole region and making electrostatic attraction act on said slant face of said plate-like member, and two or more convex parts are formed on said slant face, Optical deflection equipment displacing said plate-like member with electrostatic attraction from said slant face, the direction of an optical deflection being prescribed by by contacting to said convex part, and said convex part's being arranged by band-like [two or more], and forming said electrode in a flat part around this convex part.

[Claim 97]

Optical deflection equipment characterized by the upper surface whole region of said plate-like member being said light reflex field in optical deflection equipment of any one description of the Claims 88-96.

[Claim 98]

Optical deflection equipment, wherein said plate-like member is constituted by lamination with a dielectric layer which consists of a component which has a dielectric, and said conductor layer in optical deflection equipment of any one description of the Claims 88-97.

[Claim 99]

Optical deflection equipment characterized by specific inductive capacity of said dielectric layer being three or more in the optical deflection equipment according to claim 98.

[Claim 100]

Optical deflection equipment, wherein said dielectric layer of said plate-like member is constituted with a silicon nitride film in the optical deflection equipment according to claim 98 or 99.

[Claim 101]

Optical deflection equipment, wherein said electrode is provided in a position which counters the rear-face side of said plate-like member in optical deflection equipment of any one description of the Claims 88-100 and this electrode is electrically separated

from said crowning of said fulcrum member.
[Claim 102]
Optical deflection equipment, wherein said at least a part of conductor layer of said plate-like member has countered with said electrode in the optical deflection equipment according to claim 101.
[Claim 103]
Optical deflection equipment, wherein said regulating member has the extended base projected to an opposite direction with a projection direction of a top stopper in a lower end part in optical deflection equipment of any one description of the Claims 88-102.
[Claim 104]
Optical deflection equipment with which light flux which enters into this light reflex field by being displaced with electrostatic attraction characterized by comprising the following according to potential given to a component which has a light reflex field changes a reflecting direction, and is deflected.
A substrate.
Two or more regulating members.
A fulcrum member.
It has a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, and are provided in two or more ends of said substrate, respectively, and said fulcrum member is conductivity.

[Claim 105]
arranging said regulating member or a compound regulating member on the circumference of said substrate in the optical deflection array according to claim 104 at six regular intervals -- said optical deflection equipment -- two-dimensional -- the maximum -- an optical deflection array arranging densely.
[Claim 106]
An optical deflection array, wherein said regulating member has the extended base projected to an opposite direction with a projection direction of a top stopper in a lower end part in the optical deflection array according to claim 104 or 105.
[Claim 107]
In an optical deflection array of any one description of the Claims 104-106, said compound regulating member, An optical deflection array being a form where provided a straight part in both ends to which a plate-like base which lies on a substrate ranging over division into equal parts counters both substrates on a boundary line of two adjoining substrates, and a stopper which projects at said boundary line and an opposite direction was formed in a crowning of both straight parts, respectively.
[Claim 108]
An optical deflection array, wherein said compound regulating member has a stopper which provides a straight part on a substrate at both substrates ranging over division into equal parts, and projects bidirectionally on a boundary line of two adjoining substrates at a crowning of this straight part in an optical deflection array of any one description of the Claims 104-106.
[Claim 109]
A manufacturing method of optical deflection equipment of any one description of the Claims 88-103 characterized by comprising the following.
A process of forming said fulcrum member at least on arbitrary substrates.
A process of patternizing and forming a component which has the conductivity of two or more electrodes and said fulcrum member.
They are deposition and a process which carries out flattening about the 1st sacrifice layer.
A process of patternizing said plate-like member which consists of at least one layer, and a process of depositing the 2nd sacrifice layer, A process of patternizing the 1st sacrifice layer and 2nd sacrifice layer, a process of patternizing said regulating member in arbitrary parts of the 1st and 2nd this patternized sacrifice layers, and a process of removing the 1st and 2nd this patternized sacrifice layers by etching.

[Claim 110]
A manufacturing method of optical deflection equipment having projected a crowning of said fulcrum member in a manufacturing method of the optical deflection equipment according to claim 109 from said 1st sacrifice layer by which flattening was carried out.
[Claim 111]
A process of sticking two or more divisions one dimension or in the shape of two dimensions, forming them, and forming said fulcrum member at least for every division on arbitrary substrates, A process of patternizing and forming a component which has the conductivity of two or more electrodes and said fulcrum member, A process of patternizing said plate-like member which serves as deposition and a process which carries out flattening from at least one layer in the 1st sacrifice layer, A process of depositing the 2nd sacrifice layer, and a process of patternizing the 1st sacrifice layer and 2nd sacrifice layer, A process of patternizing said regulating member in arbitrary parts of the 1st and 2nd patternized this sacrifice layers, A manufacturing method of an optical deflection array of any one description of the Claims 104-108 having the process of removing the 1st and 2nd patternized this sacrifice layers by etching.
[Claim 112]
A manufacturing method of an optical deflection array having projected a crowning of said fulcrum member in a manufacturing method of the optical deflection array according to claim 111 from said 1st sacrifice layer by which flattening was carried out.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention about the optical transmission device possessing the image projection display device possessing the image forming device possessing the optical information processing device possessing the optical deflection method, optical deflection equipment, the manufacturing method of the optical deflection equipment, and its optical deflection equipment, and its optical deflection equipment, and its optical deflection equipment, and its optical deflection equipment, The optical deflection method of changing the reflecting direction of incident light in one axis or the biaxial direction, and performing an optical deflection in detail, And optical deflection equipment which changes the reflecting direction of incident light in one axis or the biaxial direction, and performs an optical deflection and a manufacturing method of the optical deflection equipment, And an optical information processing device which processes the light information possessing the optical deflection equipment, And an image forming device which performs optical writing by the electrophotography process possessing the optical deflection equipment, and forms a picture, And it is related with the image projection display device which projects and displays the picture possessing the optical deflection equipment, and the optical transmission device which determines the optical path of the lightwave signal possessing the optical deflection equipment, and outputs and transmits it.
This invention relates to the composition of the optical deflection equipment into which the direction of the emitted light to incident light is changed. As an applicable field, there are video devices, such as image devices, such as a device write-in [optical] in an electrophotography process, and a projector, optical communications, optical connection apparatus which change to electrical signal transfer, etc.
[0002]
[Description of the Prior Art]
The device which sags a cantilever in the optical deflection equipment which changes the reflecting direction of the incident light using electrostatic force of an optical switch device, and performs an optical deflection according to electrostatic force, and changes and switches the reflecting direction of incident light, and the optical deflection system using it are already publicly known. Again The element which drives and carries out the optical switch of the diffraction grating by electrostatic force is also publicly known (for example, the patent documents 1, the patent documents 2, the patent documents 3, the nonpatent literature 1, and nonpatent literature 2. reference).
The image forming device using the optical deflection system which has arranged "DMD" generally called a digital micro mirror device to one dimension or two dimensions is also publicly known (for example, patent documents 4. reference).
Although a mirror part inclines and it is used in a torsion beam mold or a cantilever beam mold as element structure of "DMD" generally called a digital micro mirror device, the mirror part has the structure of having at least one or more fixed ends. However, reservation of the stability of a beam is difficult for DMD generally called the digital micro mirror device (for example, nonpatent literature 3. reference) of the optical switch using a cantilever, or a cantilever beam mold, and its speed of response is also slow. Although it is shown in the nonpatent literature 3, a mirror part inclines like this invention in the digital micro mirror device of this torsion beam mold or a cantilever type and it is used, unlike the optical deflection equipment of this invention, the mirror part has the structure of having at least one or more fixed ends.
The mechanical strength of the hinge region of a torsion beam changes at the time of long term use, and DMD generally called the digital micro mirror device of a torsion beam mold deteriorates. The wavelength of the incident light for which the element which drives and carries out the optical switch of the diffraction grating by electrostatic force is used is restricted.
The element which carries out flexure deformation of the beam of a both-ends cover half cylindrical, and performs an optical deflection at high speed is also publicly known (for example, patent documents 5. reference). However, in order to have a parallel void in inter-electrode and to sag the both-ends fixed beam by the electrostatic attraction on a cylinder, ****** transformed at high speed is possible, and speed of response can be made quick, but since both ends are being fixed, driver voltage is high compared with the cantilever etc.
[0003]
From the same applicant's inventor to then, parallel. Or the substrate which changes the both-ends fixed beam in which a mirror is formed, and counters via a void according to the electrostatic force made to act on inter-electrode [through an un-parallel void] is made to contact, In the optical deflection equipment which carries out an optical deflection by changing the reflecting direction of the incoming beam which enters into a light reflection surface, Have a hollowed part on arbitrary substrates, and it has at least two or more electrodes in the arbitrary parts of this hollowed part, This electrode can give mutually different potential, and it has the beam with which the light reflex field was installed in this hollowed part and the substrate plane upper part which counters via a void, And the light modulation device which there is no state, i.e., grounded, where this beam and this light reflex field have floated electrically, and is not connected to arbitrary potential is proposed.
However, although the stability of a beam is secured and speed of response is quick similarly, since it is a both-ends fixed-beam type, driver voltage is high compared with the cantilever etc.
A biaxial movable mirror and the display device using it are also publicly known (for example, refer to patent documents 6.).
Above-mentioned 2 An axial movable mirror and the display device using it, the pickpocket who comprised a magnetic metal — voltage which is different in two or more electrodes which fixed to the mirror board by which the permanent magnet has been arranged by magnetism by the needlelike pivot, and formed the bowl-like mirror plate in the mirror board, [impress and] It is a

mirror for light scanning of a biaxial movable mirror which makes a mirror plate generate the potential difference by static electricity, and is made to rotate a mirror plate centering on the needlelike tip of a pivot so that it may approach in the direction of an electrode. However, the above-mentioned biaxial movable mirror and the display device using it have a complicated structure which the mirror plate is making fix to a mirror board in a pivot part by magnetism substantially, and are not a mirror plate of a perfect free state.
The miniaturization of a device is difficult by arranging the magnetic yoke so that a mirror plate may be constituted by the magnetic metal, a permanent magnet may be installed in the lower part of a mirror board and a mirror board may be surrounded, and it has a fault which cannot perform array-ization which arranges more than one and operates individually. Since it comprises a magnetic material and is easy to be influenced by the magnetism of the installed environment of equipment, an operating environment will be restricted.
By this invention, the magnetic material is not positively used to it.
Therefore, it is hard to be influenced by a magnetic field.

Therefore, the optical deflection method of changing the reflecting direction of the conventional incident light in one axis or the biaxial direction, and performing an optical deflection, And optical deflection equipment, a manufacturing method of the optical deflection equipment, and an optical information processing device possessing the optical deflection equipment, And the image forming device possessing the optical deflection equipment, the image projection display device possessing the optical deflection equipment, and the optical transmission device possessing the optical deflection equipment, The structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are complicated, an operation is unstable and a response is also slow, The wavelength of the incident light to be used was restricted, the mechanical strength changed at the time of long term use, and deteriorated, the energy with it was needed, and the fault a miniaturization and integration say that it is difficult and an operating environment is also restricted by a high cost had arisen.
[high driver voltage and] [big]
[0004]
[Patent documents 1]
The patent No. 2941952 gazette
[Patent documents 2]
The patent No. 3016871 gazette
[Patent documents 3]
JP,H10-510374,A
[Patent documents 4]
JP,H6-138403,A
[Patent documents 5]
JP,2000-2842,A
[Patent documents 6]
JP,H8-220455,A
[Nonpatent literature 1]
K.E. Petersen, "Applied Physics Letters", 1977, Vol.31, No.8, pp521-pp523
[Nonpatent literature 2]
D.M. Bloom, "Optics Letters", Vol.7, No.9, pp688-pp690
[Nonpatent literature 3]
L.J.Hornbeck,"Proc. SPIE",1989, Vol.1150,pp.86-102
[0005]
[Problem to be solved by the invention]
Then, SUBJECT of this invention solves such a problem. that is, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- it being easy, an operation being stable, and a response being also quick, and, Driver voltage low [without restricting the wavelength of the incident light to be used / change and degradation have few mechanical strengths also at the time of long term use, and] with saving resources. A miniaturization and integration are possible and by low cost. The image projection display device possessing the image forming device possessing the optical information processing device possessing the optical deflection method by which an operating environment is not restricted, either, optical deflection equipment, the manufacturing method of the optical deflection equipment, and its optical deflection equipment, and its optical deflection equipment, and its optical deflection equipment, and its optical deflection equipment. It aims at providing the optical transmission device to provide.
[0006]
If the purpose of this invention is described briefly, control of the deflection angle of a mirror is easy and stable, Speed of response is quick, there can be little long-term degradation, can drive by the low voltage more, and can improve the ON/OFF ratio (equivalent to the S/N ratio in picture equipment, and the contrast ratio in Electronic Image Devices Division) of a reflected light, and a miniaturization and integration are possible at low cost, And it is in providing the manufacturing method of the optical deflection equipment which makes possible the optical deflection of one axis or the biaxial direction, an optical deflection array and the image forming device using them, an image projection display device, an optical transmission device, and optical deflection equipment.
[0007]
[Means for solving problem]
To achieve the above objects, this invention of Claim 1, In.the optical deflection method of changing the reflecting direction of incident light in one axis or the biaxial direction, and performing an optical deflection, The plate shape component of the plate shape formed with the thin film which combines with the surface a reflective means to reflect incident light, and constitutes it, Displacement arranges in the state of freedom in the void formed between bamboo hat-shaped bamboo hat shape members the fulcrum member top on the above-mentioned substrate without fixing on a substrate, It is characterized [main] by being the optical deflection method of giving potential to the electrode which countered the circumference of the above-mentioned fulcrum member on the above-mentioned substrate with the above-mentioned plate shape component, and has been arranged, changing the reflecting direction of incident light by the above-mentioned reflective means on the above-mentioned plate shape component inclined and laid on the above-mentioned fulcrum member, and performing an optical deflection.

This invention of Claim 2 is characterized [main] by an electrode being the optical deflection method of giving potential which is different in two or more electrodes of each which countered the circumference of the fulcrum member on a substrate with the plate shape component, and were arranged, and performing an optical deflection in the optical deflection method according to claim 1.
In the optical deflection method according to claim 1 or 2 this invention of Claim 3, It is characterized [main] by being the optical deflection method of giving potential which is different in an electrode, contacting the slant face on a substrate in the plate shape component of the plate shape formed with the thin film which combines a reflective means with the surface and constitutes it, specifying and changing the reflecting direction of incident light in the position which contacts, and performing an optical deflection.
[0008]
In the optical deflection equipment which this invention of Claim 4 changes the reflecting direction of incident light in one axis or the biaxial direction, and performs an optical deflection, A reflective means to reflect incident light, and the plate shape component of the plate shape formed with the thin film which combines the above-mentioned reflective means with the surface, and constitutes it, The fulcrum member used as the fulcrum at the time of displacement of the inclining above-mentioned plate shape component on the substrate laid without fixing the above-mentioned plate shape component, and the above-mentioned substrate, It is characterized [main] by being optical deflection equipment which consists of an electrode which countered the circumference of the bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in the above-mentioned plate shape component on the above-mentioned fulcrum member, and the above-mentioned fulcrum member on the above-mentioned substrate with the rear face of the above-mentioned plate shape component, and has been arranged.
This invention of Claim 5 is Claim 4. In the optical deflection equipment of a description, the reflector of a reflective means is characterized [main] by being monotonous and formed optical deflection equipment.
This invention of Claim 6 is characterized [main] by a reflective means being optical deflection equipment currently formed with the aluminum system metal membrane in the optical deflection equipment according to claim 4 or 5.
This invention of Claim 7 is characterized [main] by a plate shape component being optical deflection equipment which becomes the face shape of the part which touches a fulcrum member from the curved shape section of curved shape in the optical deflection equipment according to claim 4, 5, or 6.
This invention of Claim 8 is characterized [main] by a plate shape component being optical deflection equipment whose outside is a circle configuration in the optical deflection equipment according to claim 4, 5, 6, or 7. This invention of Claim 9 is characterized [main] by a plate shape component being optical deflection equipment which consists of silicon nitride films in the optical deflection equipment according to claim 4, 5, 6, 7, or 8.
This invention of Claim 10 is Claims 4, 5, 6 and 78. Or in optical deflection equipment given in 9, a reflective means or a plate shape component has a conductive area which has conductivity, and is characterized [main] by the above-mentioned conductive areas being an electrode and optical deflection equipment which counters.
This invention of Claim 11 is characterized [main] by a substrate being optical deflection equipment which consists of a hollow-shaped hollow form part in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, or 10.
[0009]
This invention of Claim 12 is characterized [main] by a substrate being optical deflection equipment which consists of a silicon substrate which has a plane direction (100) in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, 10, or 11.
This invention of Claim 13 is characterized [main] by a fulcrum member being optical deflection equipment whose face shape of the part which touches a plate shape component is a circular shaped part in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, 10, 11, or 12.
This invention of Claim 14 is characterized [main] by a fulcrum member being optical deflection equipment which is a conical shape part which touches a plate shape component at a point in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, 10, 11, or 12.
This invention of Claim 15 is characterized [main] by a fulcrum member being optical deflection equipment whose field which touches a plate shape component is a rectangular rectangular form part in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, 10, 11, or 12.
This invention of Claim 16 is characterized [main] by a fulcrum member being optical deflection equipment which is a ridge form part which consists of form of the ridge which touches a plate shape component by a line in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, 10, 11, or 12.
This invention of Claim 17 is characterized [main] by a fulcrum member being optical deflection equipment which has a slant face which touches a plate shape component in the optical deflection equipment according to claim 4, 5, 6, 7, 8, 9, 10, 11, or 12.
This invention of Claim 18 is characterized [main] by a fulcrum member being optical deflection equipment which consists of a silicon oxide film or a silicon nitride film in the optical deflection equipment according to any one of claims 4 to 17.
This invention of Claim 19 is characterized [main] by a bamboo hat shape member being optical deflection equipment which vacated the predetermined interval and has arranged two or more bamboo hat shape members of each corresponding to the periphery of a plate shape component in the optical deflection equipment according to any one of claims 4 to 18.
[0010]
This invention of Claim 20 is characterized [main] by a bamboo hat shape member being optical deflection equipment arranged to all the fields corresponding to the periphery of a plate shape component in the optical deflection equipment according to any one of claims 4 to 18.
This invention of Claim 21 is characterized [main] by a bamboo hat shape member being optical deflection equipment which consists of an insulator layer which has insulation in the optical deflection equipment according to any one of claims 4 to 20.
This invention of Claim 22 is characterized [main] by a bamboo hat shape member being optical deflection equipment which consists of a translucency film which has translucency to an incoming beam in the optical deflection equipment according to any one of claims 4 to 21.
This invention of Claim 23 is characterized [main] by a bamboo hat shape member being optical deflection equipment which consists of silicon oxide films in the optical deflection equipment according to any one of claims 4 to 22.
This invention of Claim 24 is characterized [main] by a bamboo hat shape member being optical deflection equipment which consists of a shading film which has a light sheilding to an incoming beam in the optical deflection equipment according to any one of claims 4 to 23.

This invention of Claim 25 is characterized [main] by a bamboo hat shape member being optical deflection equipment which consists of chromium oxide films in the optical deflection equipment according to any one of claims 4 to 24.
As for this invention of Claim 26, an electrode consists of two or more electrodes of each in the optical deflection equipment according to any one of claims 4 to 25, and it is characterized [main] by a plate shape component being optical deflection equipment which has floated electrically.
This invention of Claim 27 is characterized [main] by two or more electrodes of each being optical deflection equipment arranged on a rear face of a plate shape component, and a slant face which countered in the optical deflection equipment according to claim 26.
This invention of Claim 28 is characterized [main] by being the optical deflection equipment in which a one-dimensional optical deflection array arranged to one-dimensional array form was formed in two or more optical deflection equipment according to any one of claims 4 to 27.
This invention of Claim 29 is characterized [main] by being the optical deflection equipment in which a two-dimensional optical deflection array arranged to two-dimensional array form was formed in two or more optical deflection equipment according to any one of claims 4 to 28.
[0011]
In the manufacturing method of the optical deflection equipment according to any one of claims 4 to 29 which this invention of Claim 30 changes the reflecting direction of incident light in one axis or the biaxial direction, and performs an optical deflection, The plate shape component of the plate shape formed with the thin film which combines the above-mentioned reflective means with the surface, and constitutes it via the 1st sacrifice layer that formed the fulcrum member and the electrode, and deposited and carried out flattening on the substrate is formed, After patternizing a bamboo hat shape member to the position which patternized the 2nd deposited sacrifice layer, it is characterized [main] by being a manufacturing method of the optical deflection equipment from which the 1st sacrifice layer of the above and the 2nd sacrifice layer of the above are removed.
In the manufacturing method of the optical deflection equipment according to claim 30 this invention of Claim 31, The plate shape component which consists of a curved shape section of the curved shape which formed the fulcrum member and the electrode on the substrate and was formed with the thin film which combines the above-mentioned reflective means with the surface, and constitutes it via the 3rd sacrifice layer that the above-mentioned fulcrum member was made to project and was deposited, was deposited on the 1st sacrifice layer that carried out flattening in piles, and carried out flattening to it is formed, After patternizing a bamboo hat shape member to the position which patternized the 2nd deposited sacrifice layer, it is characterized [main] by being a manufacturing method of the optical deflection equipment from which the 1st sacrifice layer of the above, the 2nd sacrifice layer of the above, and the 3rd sacrifice layer of the above are removed.
In the manufacturing method of the optical deflection equipment according to claim 30 this invention of Claim 32, The plate shape component of the plate shape formed with the thin film which combines the above-mentioned reflective means with the surface, and constitutes it via the 1st sacrifice layer that formed the fulcrum member and electrode which become depressed on a substrate and become a form part and the above-mentioned hollow form circles from a slant face, and deposited and carried out flattening is formed, After patternizing a bamboo hat shape member to the position which patternized the 2nd deposited sacrifice layer, it is characterized [main] by being a manufacturing method of the optical deflection equipment from which the 1st sacrifice layer of the above and the 2nd sacrifice layer are removed.
This invention of Claim 33 is characterized [main] by being a manufacturing method of optical deflection equipment which removes a sacrifice layer from a predetermined interval which has vacated and arranged between each bamboo hat shape member of plurality of a bamboo hat shape member in a manufacturing method of the optical deflection equipment according to claim 30, 31, or 32.
In an optical information processing device which processes light information using optical deflection equipment which this invention of Claim 34 changes a reflecting direction of incident light in one axis or the biaxial direction, and performs an optical deflection, It is characterized [main] by being an optical information processing device which becomes any 1 clause of two or more above-mentioned Claims 4-29 from an independent drive means to drive respectively optical deflection equipment and two or more above-mentioned optical deflection equipment of a description independently.
[0012]
In an image forming device which this invention of Claim 35 performs optical writing by an electrophotography process, and forms a picture, A latent image formation means which becomes any 1 clause of the above-mentioned Claims 4-29 which perform optical writing and form a latent image on picture support which is held rotatable and supports a formed image, and described image support from optical deflection equipment of a description, It is characterized [main] by being an image forming device which consists of a developing means which develops a latent image formed by the above-mentioned optical deflection equipment of the above-mentioned latent image formation means, and forms a toner image, and a transfer means which transfers a toner image formed by the above-mentioned developing means to a transferred object.
In an image projection display device which this invention of Claim 36 projects a picture and is displayed, An optical switch means which consists of the optical deflection equipment according to any one of claims 4 to 29 which changes a reflecting direction of incident light of image projection data, performs an optical deflection, and projects and displays a picture, It is characterized [main] by being an image projection display device which consists of a projection screen which displays a picture which the above-mentioned optical switch means projects.
In an optical transmission device which this invention of Claim 37 determines an optical path of a lightwave signal, and is outputted and transmitted, Change a reflecting direction of incident light of a lightwave signal from a lightwave signal input means which inputs a lightwave signal, and the above-mentioned lightwave signal input means in one axis or the biaxial direction, and an optical deflection is performed, It is characterized [main] by being an optical transmission device which consists of an optical switch means which consists of the optical deflection equipment according to any one of claims 4 to 29 which determines an optical path of each lightwave signal, and a lightwave signal output means which outputs a lightwave signal from the above-mentioned optical switch means.
This invention of Claim 38 is characterized [main] by an optical switch means being an optical transmission device which consists of two or more steps of pieces of optical deflection equipment in the optical deflection equipment according to claim 37.

[0013]
In the invention according to claim 39, it is characterized by said fulcrum member being 4 pyramid form of contacting at said plate shape component and a point in optical deflection equipment of any one description of the Claims 4-12.

In the invention according to claim 40, a size of the bottom of a fulcrum member of said 4 pyramid form is characterized by being almost equal to a size of said plate shape component in the optical deflection equipment according to claim 39.
In the invention according to claim 41, in optical deflection equipment of any one description of the Claims 4-16, when said plate shape component is displaced with electrostatic attraction, a reflecting direction of an incoming beam is determined by contacting by said substrate, point, or a line.
[0014]
In optical deflection equipment which changes a reflecting direction of incident light into two or more shaft orientations, and performs an optical deflection in the invention according to claim 42, A substrate laid without fixing a plate shape component and the above-mentioned plate shape component of plate shape which has a reflex function which reflects incident light, A fulcrum member used as a fulcrum at the time of displacement of the inclining above-mentioned plate shape component on the above-mentioned substrate, It consists of an electrode which countered the circumference of a bamboo hat shape member of bamboo hat form which forms a void where displacement is arranged in the state of freedom in the above-mentioned plate shape component on the above-mentioned fulcrum member, and the above-mentioned fulcrum member on the above-mentioned substrate with a rear face of the above-mentioned plate shape component, and has been arranged.
In the invention according to claim 43, said plate shape component is formed with a monolayer thin film in the optical deflection equipment according to claim 42.
[0015]
In the invention according to claim 44, in the optical deflection equipment according to claim 42 or 43, a reflector of a reflective means is monotonous and is formed.
In the invention according to claim 45, a reflective means is formed with an aluminum system metal membrane in optical deflection equipment of any one description of the Claims 42-44.
In the invention according to claim 46, a plate shape component becomes the face shape of a part which touches a fulcrum member from a curved shape section of curved shape in optical deflection equipment of any one description of the Claims 42-45.

[0016]
in the invention according to claim 47, it resembles any one of the Claims 42-46, and a plate shape component is characterized by an outside being a circle configuration in optical deflection equipment of a description. in the invention according to claim 48, it resembles any one of the Claims 42-47, a reflective means or a plate shape component has a conductive area which has conductivity in optical deflection equipment of a description, and the above-mentioned conductive area counters with an electrode
in the invention according to claim 49, it resembles any one of the Claims 42-48, and a substrate consists of a hollow-shaped hollow form part in optical deflection equipment of a description
[0017]
in the invention according to claim 50, it resembles any one of the Claims 42-49, and a substrate consists of a silicon substrate which has a plane direction (100) in optical deflection equipment of a description
in the invention according to claim 51, it resembles any one of the Claims 42-50, and a fulcrum member is characterized by the face shape of the part which touches a plate shape component being a circular shaped part in the optical deflection equipment of a description.
in the invention according to claim 52, it resembles any one of the Claims 42-50, and a fulcrum member is characterized by being a conical shape part which touches a plate shape component at a point in the optical deflection equipment of a description.
[0018]
in the invention according to claim 53, it resembles any one of the Claims 42-50, and a fulcrum member is characterized by the field which touches a plate shape component being a rectangular rectangular form part in the optical deflection equipment of a description.
In the invention according to claim 54, it is characterized by said fulcrum member being 4 pyramid form of contacting at said plate-like member and a point in the optical deflection equipment of any one description of the Claims 42-50.
In the invention according to claim 55, the size of the bottom of the fulcrum member of said 4 pyramid form is characterized by being almost equal to the size of said plate-like member in the optical deflection equipment according to claim 54.
[0019]
In the invention according to claim 56, in the optical deflection equipment of any one description of the Claims 42-53, when said plate-like member is displaced with electrostatic attraction, the reflecting direction of an incoming beam is determined by contacting by said substrate, the point, or a line.
in the invention according to claim 57, it resembles any one of the Claims 42-56, and a fulcrum member has a slant face which touches a plate shape component in the optical deflection equipment of a description
[0020]
By being displaced with the electrostatic attraction according to the potential given to the component which has a light reflex field in the invention according to claim 58, In the optical deflection equipment with which the light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate, respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and the point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in the space between said substrate, said fulcrum member, and said stopper, and contact with said fulcrum member gives the potential of said plate-like member.
[0021]
In the invention according to claim 59, it is characterized by the upper surface whole region of said plate-like member being said light reflex field in the optical deflection equipment according to claim 58.
In the optical deflection equipment according to claim 58 or 59, said plate-like member is constituted from invention according to claim 60 by lamination with the dielectric layer which consists of a component which has a dielectric, and said conductor layer.
[0022]
In the invention according to claim 61, it is characterized by the specific inductive capacity of said dielectric layer being three or

more in the optical deflection equipment according to claim 60.
In the optical deflection equipment according to claim 60 or 61, said dielectric layer of said plate-like member is constituted from the invention according to claim 62 by the silicon nitride film.
[0023]
In the invention according to claim 63, in the optical deflection equipment of any one description of the Claims 58-62, two or more electrodes are formed on said substrate which counters the rear-face side of said plate-like member, and this electrode is electrically separated from said crowning of said fulcrum member.
In the invention according to claim 64, said at least a part of conductor layer of said plate-like member has countered with said electrode in the optical deflection equipment according to claim 63.
[0024]
In the invention according to claim 65, in the optical deflection equipment of any one description of the Claims 58-64, said plate-like member and said fulcrum member have touched at the point mostly, and said fulcrum member is characterized by being a cone.
In the invention according to claim 66, it is characterized by being a polygonal-pyramid object in which said plate-like member and said fulcrum member have touched at the point mostly, and said fulcrum member has two or more slant faces in the optical deflection equipment of any one description of the Claims 58-64.
[0025]
In the invention according to claim 67, it is characterized by being a columnar body in which said plate-like member and said fulcrum member have touched by the line mostly, and said fulcrum member has a slant face, and a crowning has ** in which said plate-like member and line contact are possible in the optical deflection equipment of any one description of the Claims 58-64.
In the invention according to claim 68, said slant face carries out two or more owners of the electrode for [of said plate-like member] being mostly formed corresponding to the whole region and making electrostatic attraction act on said slant face in the optical deflection equipment according to claim 66 or 67.
[0026]
By the invention according to claim 69, in the optical deflection equipment according to claim 68, said plate-like member is displaced with the electrostatic attraction from said slant face, and the direction of an optical deflection is specified by contacting to said slant face.
By the invention according to claim 70, in the optical deflection equipment according to claim 68, two or more convex parts are formed on said slant face, and said plate-like member is displaced with the electrostatic attraction from said slant face, and the direction of an optical deflection is specified by contacting to said convex part.
[0027]
In the invention according to claim 71, it is characterized by atmosphere near said plate-like member being a vacuum mostly in optical deflection equipment of any one description of the Claims 58-70.
In the invention according to claim 72, atmosphere near said plate-like member is characterized by being the atmosphere of an inertness gas in optical deflection equipment of any one description of the Claims 58-70.
[0028]
In optical deflection equipment of any one description of the Claims 63-72 in the invention according to claim 73, Potential which gives respectively arbitrary potential so that maximum potential difference may become said two or more electrodes beyond a specified value, and is given to said crowning is made equal to the maximum of potential and one value of the minimums which are given to said two or more electrodes.
In optical deflection equipment of any one description of the Claims 63-72 in the invention according to claim 74, About a straight line which passes along said crowning which serves as an axis of displacement of said plate-like member among said two or more electrodes, Let potential which gives respectively arbitrary potential so that maximum potential difference may become in an electrode which exists in the same side beyond a specified value, and is given to said crowning be the maximum of potential and an abbreviated mean value of the minimum which are given to said two or more electrodes.
[0029]
In the invention according to claim 75, it is characterized by said conductor layer being an aluminum system metal membrane in optical deflection equipment of any one description of the Claims 58-74.
In the invention according to claim 76, said conductor layer serves as said light reflex field in the optical deflection equipment according to claim 75.
In the invention according to claim 77, optical deflection equipment of any one description of the Claims 58-76 has been arranged to one dimension or two-dimensional array form on plurality and arbitrary substrates.
[0030]
In the invention according to claim 78, in an image projection display device, optical deflection equipment of any one description of the Claims 58-76, Or the optical deflection array according to claim 77 is used as an optical switch means which changes a reflecting direction of incident light according to image data, and a picture by said image data is projected on a screen. In the invention according to claim 79, in the image projection display device according to claim 78, a normal line direction of a light reflection surface in case said plate-like member of said optical deflection equipment is in a center valve position arranges so that it may become in the direction mostly with the operation direction of gravity.
[0031]
In the invention according to claim 80, the optical deflection array according to claim 77 is used as a line exposure type latent image formation means in an image forming device.
In the invention according to claim 81, in the image forming device according to claim 80, a normal line direction of a light reflection surface in case said plate-like member of said optical deflection equipment is in a center valve position arranges so that it may become in the direction mostly with the operation direction of gravity.
[0032]
In the invention according to claim 82, transmission of light information is changed in an optical transmission device between one input/output port and arbitrary ports in two or more input/output port, using optical deflection equipment of any one description of the Claims 68-76 as an optical switch means.
In the invention according to claim 83, the optical deflection array according to claim 77 is used as an optical switch means in an optical transmission device, Transmission of light information is changed, respectively between arbitrary ports in two or more input/output port of one input output section, and arbitrary ports in input/output port of plurality of an input output section of

another side.
In the invention according to claim 84, in the optical transmission device according to claim 83, a normal line direction of a light reflection surface in case said plate-like member of said optical deflection equipment is in a center valve position arranges so that it may become in the direction mostly with the operation direction of gravity.
[0033]
In a manufacturing method of optical deflection equipment of any one description of the Claims 58-76 in the invention according to claim 85, A process which patternizes a process of forming said fulcrum member at least, and a component which has the conductivity of two or more electrodes and said fulcrum member at an arbitrary substrate top, and is formed, A process of patternizing said plate-like member which serves as deposition and a process which carries out flattening from at least one layer in the 1st sacrifice layer, A process of depositing the 2nd sacrifice layer, and a process of patternizing the 1st sacrifice layer and 2nd sacrifice layer, It has a process of patternizing said regulating member in arbitrary parts of the 1st and 2nd patternized this sacrifice layers, and the process of removing the 1st and 2nd this patternized sacrifice layers by etching.
[0034]
In the manufacturing method of the optical deflection array according to claim 77 by the invention according to claim 86, The process of sticking two or more divisions one dimension or in the shape of two dimensions, forming them, and forming said fulcrum member at least for every division on arbitrary substrates, The process of patternizing and forming the component which has the conductivity of two or more electrodes and said fulcrum member, The process of patternizing said plate-like member which serves as deposition and a process which carries out flattening from at least one layer in the 1st sacrifice layer, The process of depositing the 2nd sacrifice layer, and the process of patternizing the 1st sacrifice layer and 2nd sacrifice layer, It has the process of patternizing said regulating member in the arbitrary parts of the 1st and 2nd patternized this sacrifice layers, and the process of removing the 1st and 2nd this patternized sacrifice layers by etching.
[0035]
In the invention according to claim 87, it has at least a process which makes a thin film deposit on two or more electrodes, and the process of patternizing this thin film and forming a convex part, in the manufacturing method of the optical deflection equipment according to claim 70.
[0036]
By being displaced with the electrostatic attraction according to the potential given to the component which has a light reflex field in the invention according to claim 88, In the optical deflection equipment with which the light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate, respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and the point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in the space between said substrate, said fulcrum member, and said stopper, It had two or more electrodes for making electrostatic attraction act on said substrate, the potential of said plate-like member was given by contact with said fulcrum member, said plate-like member and said fulcrum member have touched at the point mostly, said fulcrum member is a cone, and it is characterized by the crowning of this cone being spherical.
[0037]
By being displaced with the electrostatic attraction according to the potential given to the component which has a light reflex field in the invention according to claim 89, In the optical deflection equipment with which the light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate, respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and the point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in the space between said substrate, said fulcrum member, and said stopper, Had two or more electrodes for making electrostatic attraction act on said substrate, the potential of said plate-like member was given by contact with said fulcrum member, said plate-like member and said fulcrum member have touched at the point mostly, and said fulcrum member A cone, It is characterized by being the form which made the pillar which has the bottom of the path and equal diameter of this bottom under this cone bottom unite.
[0038]
By being displaced with the electrostatic attraction according to the potential given to the component which has a light reflex field in the invention according to claim 90, In the optical deflection equipment with which the light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate, respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and the point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in the space between said substrate, said fulcrum member, and said stopper, It had two or more electrodes for making electrostatic attraction act on said substrate, the potential of said plate-like member was given by contact with said fulcrum member, said plate-like member and said fulcrum member have touched at the point mostly, and it is characterized by said fulcrum member being truncated cone shape.
[0039]
By being displaced with the electrostatic attraction according to the potential given to the component which has a light reflex field in the invention according to claim 91, In the optical deflection equipment with which the light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate, respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not

have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and the point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in the space between said substrate, said fulcrum member, and said stopper, Had two or more electrodes for making electrostatic attraction act on said substrate, the potential of said plate-like member was given by contact with said fulcrum member, said plate-like member and said fulcrum member have touched at the point mostly, and said fulcrum member A truncated cone, It is characterized by being the form which made the pillar which has the bottom of the path and equal diameter of this bottom under this truncated cone bottom unite.

[0040]

By being displaced with the electrostatic attraction according to the potential given to the component which has a light reflex field in the invention according to claim 92, In the optical deflection equipment with which the light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate, respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and the point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in the space between said substrate, said fulcrum member, and said stopper, It had two or more electrodes for making electrostatic attraction act on said substrate, the potential of said plate-like member was given by contact with said fulcrum member, said plate-like member and said fulcrum member have touched at the point mostly, and it is characterized by said fulcrum member being a pillar.

[0041]

By being displaced with the electrostatic attraction according to the potential given to the component which has a light reflex field in the invention according to claim 93, In the optical deflection equipment with which the light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate, respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and the point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in the space between said substrate, said fulcrum member, and said stopper, The potential of said plate-like member was given by contact with said fulcrum member, and said plate-like member and said fulcrum member have touched at the point mostly, And said fulcrum member is a polygonal-pyramid object which has two or more slant faces, said slant face carries out two or more owners of the electrode for being mostly formed corresponding to the whole region and making electrostatic attraction act on said slant face of said plate-like member, and two or more convex parts are formed on said slant face, Said plate-like member is displaced with the electrostatic attraction from said slant face, the direction of an optical deflection is prescribed by by contacting to said convex part, and said convex part is arranged by band-like [two or more] on the electrode.

[0042]

By being displaced with the electrostatic attraction according to the potential given to the component which has a light reflex field in the invention according to claim 94, In the optical deflection equipment with which the light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate, respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and the point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in the space between said substrate, said fulcrum member, and said stopper, The potential of said plate-like member was given by contact with said fulcrum member, and said plate-like member and said fulcrum member have touched at the point mostly, And said fulcrum member is a polygonal-pyramid object which has two or more slant faces, said slant face carries out two or more owners of the electrode for being mostly formed corresponding to the whole region and making electrostatic attraction act on said slant face of said plate-like member, and two or more convex parts are formed on said slant face, Said plate-like member is displaced with the electrostatic attraction from said slant face, the direction of an optical deflection is prescribed by by contacting to said convex part, said convex part is arranged by band-like [two or more], and said electrode is formed in the flat part around this convex part.

[0043]

By being displaced with the electrostatic attraction according to the potential given to the component which has a light reflex field in the invention according to claim 95, In the optical deflection equipment with which the light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate, respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and the point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in the space between said substrate, said fulcrum member, and said stopper, The potential of said plate-like member was given by contact with said fulcrum member, and said plate-like member and said fulcrum member have touched by the line mostly, And said fulcrum member has a slant face, crownings are said plate-like member and a columnar body which has ** in which line contact is possible, and said slant face carries out two or more owners of the electrode for being mostly formed corresponding to the whole region and making electrostatic attraction act on said slant face of said plate-like member, Two or more convex parts are formed on said slant face, said plate-like member is displaced with the electrostatic attraction from said slant face, the direction of an optical deflection is prescribed by by contacting to said convex part, and said convex part is arranged by band-like [two or more] on the electrode.

[0044]

By being displaced with the electrostatic attraction according to the potential given to the component which has a light reflex field in the invention according to claim 96, In the optical deflection equipment with which the light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate, respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and the point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in the space between said substrate, said fulcrum member, and said stopper, The potential of said plate-like member was given by contact with said fulcrum member, and said plate-like member and said fulcrum member have touched by the line mostly, And said fulcrum member has a slant face, crownings are said plate-like member and a columnar body which has ** in which line contact is possible, and said slant face carries out two or more owners of the electrode for being mostly formed corresponding to the whole region and making electrostatic attraction act on said slant face of said plate-like member, Two or more convex parts are formed on said slant face, said plate-like member is displaced with the electrostatic attraction from said slant face, the direction of an optical deflection is prescribed by by contacting to said convex part, said convex part is arranged by band-like [two or more], and said electrode is formed in the flat part around this convex part.

[0045]

In the invention according to claim 97, it is characterized by the upper surface whole region of said plate-like member being said light reflex field in optical deflection equipment of any one description of the Claims 88-96.

[0046]

In optical deflection equipment of any one description of the Claims 88-97, said plate-like member is constituted from invention according to claim 98 by lamination with a dielectric layer which consists of a component which has a dielectric, and said conductor layer.

[0047]

In the invention according to claim 99, it is characterized by specific inductive capacity of said dielectric layer being three or more in the optical deflection equipment according to claim 98.

[0048]

In the optical deflection equipment according to claim 98 or 99, said dielectric layer of said plate-like member is constituted from the invention according to claim 100 by silicon nitride film.

[0049]

In the invention according to claim 101, in optical deflection equipment of any one description of the Claims 88-100, said electrode is provided in a position which counters the rear-face side of said plate-like member, and this electrode is electrically separated from said crowning of said fulcrum member.

[0050]

In the invention according to claim 102, said at least a part of conductor layer of said plate-like member has countered with said electrode in the optical deflection equipment according to claim 101.

[0051]

In the invention according to claim 103, said regulating member has the extended base projected to the opposite direction in a lower end part with the projection direction of a top stopper in the optical deflection equipment of any one description of the Claims 88-102.

[0052]

By being displaced with the electrostatic attraction according to the potential given to the component which has a light reflex field in the invention according to claim 104, In the optical deflection equipment with which the light flux which enters into this light reflex field changes a reflecting direction, and is deflected, Have a substrate, two or more regulating members, a fulcrum member, and a plate-like member, and said two or more regulating members have a stopper in the upper part, respectively, It is provided in two or more ends of said substrate, respectively, and said fulcrum member has a crowning which comprises a component which has conductivity, It is provided in the upper surface of said substrate, and said plate-like member does not have a fixed end, but it has said light reflex field on the upper surface, Have a conductor layer which consists of a component which has conductivity in part at least, and the point of contact on the back which touches said crowning at least consists of a component which has conductivity, It is arranged in movable in the space between said substrate, said fulcrum member, and said stopper, The optical deflection equipment which gives the potential of said plate-like member by contact with said fulcrum member Plurality, On arbitrary substrates, it arranges to one dimension or two-dimensional array form, said substrate of said optical deflection equipment is made circular, the position of said regulating member of adjoining substrates is coincided, both regulating members are unified, and it is considered as a compound regulating member.

[0053]

arranging said regulating member or a compound regulating member on the circumference of said substrate in the optical deflection array according to claim 104 in the invention according to claim 105 at six regular intervals -- said optical deflection equipment -- two-dimensional -- the maximum -- it arranged densely

[0054]

In the invention according to claim 106, said regulating member has the extended base projected to the opposite direction in a lower end part with the projection direction of a top stopper in the optical deflection array according to claim 104 or 105.

[0055]

In the invention according to claim 107, in the optical deflection array of any one description of the Claims 104-106, said compound regulating member, It is characterized by being a form where provided the straight part in the both ends to which the plate-like base which lies on a substrate ranging over division into equal parts counters both substrates on the boundary line of two adjoining substrates, and the stopper which projects at said boundary line and an opposite direction was formed in the crowning of both straight parts, respectively.

[0056]

In the invention according to claim 108, in the optical deflection array of any one description of the Claims 104-106, said compound regulating member, It has a stopper which provides a straight part on a substrate at both substrates ranging over division into equal parts, and projects bidirectionally in the crowning of this straight part on the boundary line of two adjoining

substrates.
[0057]
A process of forming said fulcrum member at least on arbitrary substrates in the invention according to claim 109, A process of patternizing and forming a component which has the conductivity of two or more electrodes and said fulcrum member, A process of patternizing said plate-like member which serves as deposition and a process which carries out flattening from at least one layer in the 1st sacrifice layer, A process of depositing the 2nd sacrifice layer, and a process of patternizing the 1st sacrifice layer and 2nd sacrifice layer, It is characterized by a manufacturing method of optical deflection equipment of any one description of the Claims 128-143 which have a process of patternizing said regulating member in arbitrary parts of the 1st and 2nd patternized this sacrifice layers, and the process of removing the 1st and 2nd this patternized sacrifice layers by etching.
[0058]
In the invention according to claim 110, a crowning of said fulcrum member is projected in a manufacturing method of the optical deflection equipment according to claim 109 from said 1st sacrifice layer by which flattening was carried out.
[0059]
A process of sticking two or more divisions one dimension or in the shape of two dimensions, forming them, and forming said fulcrum member at least for every division on arbitrary substrates in the invention according to claim 111, A process of patternizing and forming a component which has the conductivity of two or more electrodes and said fulcrum member, A process of patternizing said plate-like member which serves as deposition and a process which carries out flattening from at least one layer in the 1st sacrifice layer, A process of depositing the 2nd sacrifice layer, and a process of patternizing the 1st sacrifice layer and 2nd sacrifice layer, A process of patternizing said regulating member in arbitrary parts of the 1st and 2nd patternized this sacrifice layers, It is characterized by a manufacturing method of an optical deflection array of any one description of the Claims 144-148 which have the process of removing the 1st and 2nd patternized this sacrifice layers by etching.
[0060]
In the invention according to claim 112, the crowning of said fulcrum member is projected in the manufacturing method of the optical deflection array according to claim 111 from said 1st sacrifice layer by which flattening was carried out.
[0061]
[Mode for carrying out the invention]
Next, an embodiment of the invention is described in detail with reference to Drawings.
Drawing 1 and drawing 2 are a sectional view of the optical deflection equipment concerning a 1st embodiment of this invention, and a top view, and the reflecting direction of incident light One axis, Or the optical deflection equipment 0 which changes in the biaxial direction and performs an optical deflection, The reflective means 1 provided with the reflector in which incident light is reflected, and the plate shape component 2 of the plate shape formed with the thin film which combines the reflective means 1 with the surface and constitutes it, The silicon substrate 3b which has a plane direction (100) of the substrate 3 laid without fixing the plate shape component 2, The fulcrum member 4 used as the fulcrum at the time of displacement of the inclining plate shape component 2 on the silicon substrate 3b which has the above-mentioned (100) plane direction of the substrate 3, The bamboo hat shape member 5 of the bamboo hat form which forms the void (G) where displacement is arranged in the state of freedom in the plate shape component 2 on the fulcrum member 4, It consists of the electrode 6 which countered the circumference of the fulcrum member 4 on the silicon substrate 3b which has the above-mentioned (100) plane direction of the substrate 3 with the rear face of the plate shape component 2, and has been arranged, Displacement arranges in the state of freedom in the void (G) formed between the fulcrum member 4 top on the silicon substrate 3b which has the above-mentioned (100) plane direction of the substrate 3 without fixing the reflective means 1 and the plate shape component 2 on the silicon substrate 3b which has the above-mentioned (100) plane direction of the substrate 3, and the bamboo hat shape member 5, Potential is given to the electrode 6 which countered the circumference of the fulcrum member 4 on the silicon substrate 3b which has the above-mentioned (100) plane direction of the substrate 3 with the plate shape component 2, and has been arranged, Since the reflecting direction of incident light is changed by the reflective means 1 on the plate shape component 2 inclined and laid on the fulcrum member 4 and it was made to perform an optical deflection, the reflecting direction of incident light One axis, or the structure and control which change in the biaxial direction and perform an optical deflection are easy -- a response being also quick, change and degradation having few mechanical strengths also at the time of long term use, and driver voltage being [it is easy and an operation is stable,] low, without restricting the wavelength of the incident light to be used, and with saving resources. A miniaturization and integration are possible, the yield is also high, and an operating environment is not restricted by low cost, either.
[0062]
The plate shape component 2 of the plate shape formed with the thin film which combines the reflective means 1 with the surface and constitutes it, A shock since it was formed with the thin film so that it might mention later, when weight is reduced and the plate shape component 2 collides with the bamboo hat shape member 5 at the time of standby, A shock when the plate shape component 2 contacts the substrate 3 at the time of operation can be reduced, and a mechanical strength can provide now the optical deflection equipment 0 with little change and degradation also at the time of long term use.
The substrate 3 has that desirable for which silicon, glass, etc. are generally used in the semiconductor process or the liquid crystal process, when the thing of a miniaturization is taken into consideration.
The substrate 3 in the optical deflection equipment 0 is formed by the silicon substrate 3b which forms in the same substrate as a drive-system circuit, and has the above-mentioned (100) plane direction in consideration of easy composition and low-cost-izing.
The bamboo hat shape member 5 is bamboo hat form so that the movable range where the plate shape component 2 is displaced may be restricted to arbitrary voids (G), Corresponding to the periphery of the plate shape component 2, a predetermined interval (g) is vacated and two or more bamboo hat shape member $5a_1$ of each, bamboo hat shape member $5a_2$, bamboo hat shape member $5a_3$, and bamboo hat shape member $5a_4$ are arranged in four corners. Or although not illustrated, the bamboo hat shape member 5 is arranged to all the fields corresponding to the periphery of the plate shape component 2.
The bamboo hat shape member 5 is formed with the silicon oxide film 5d or the chromium oxide film 5f. Therefore, when the optical deflection equipment 0 is array-ized like the one-dimensional optical deflection array 10 which is not illustrated or the two-dimensional optical deflection array 20, in order to make the area ratio of the reflection region of the reflector 1a of the reflective means 1 into the maximum, it can constitute from a thin film and space-saving as much as possible, and the mechanical strength is strong.

The fulcrum member 4 serves as a fulcrum in case the plate shape component 2 is displaced, and according to the performance for which the optical deflection equipment 0 is asked, arbitrary form is chosen so that it may mention later. Since the fulcrum member 4 is formed with the silicon oxide film 4f or the silicon nitride film 4g, the mechanical strength is strong. However, when letting the fulcrum member 4 pass and taking the potential of the plate shape component 2, it is formed with conductive materials, such as various metal membranes.

[0063]

Drawing 3 and drawing 4 are composition and an explanatory view of operation, and in the figure, even if there are few reflective means 1 which combined with the surface of the plate shape component 2, and were constituted, the reflector 1a of a light reflex field is monotonous, and is formed. The above-mentioned reflector 1a of the reflective means 1 shows drawing 3 the mimetic diagram of a light reflex in case the above-mentioned reflector 1a of the reflective means 1 is a convex configuration like a graphic display about the mimetic diagram of the light reflex in the case of being monotonous at drawing 4.

The above-mentioned reflector 1a of the reflective means 1 is able for light flux which entered into a light reflex field to arrange a reflecting direction, and to reflect it according to a monotonous thing, as shown in drawing 3, Also when an optical change is attained only in the target reflecting direction and it uses the optical deflection equipment 0 for each optical information processing device 100, the image forming device 200 and the image projection display device 300 which are not illustrated, and optical transmission device 400 grade, without diffusing a reflected light, influence on adjacent elements is inhibited and it is important. As smoothness of the above-mentioned reflector 1a of the reflective means 1, curvature-radius Ra is wanted to be not less than several meters.

On the other hand, temporarily, as shown in drawing 4, when the above-mentioned reflector 1a of the reflective means 1 shows a convex configuration like a graphic display, since a reflecting direction is diffused and it reflects, it becomes remarkable influencing light flux which entered into a light reflex field on adjacent elements. In the described image forming device 200 and described image projection display device 300 grade which are not illustrated, about a reflected light, further, especially this becomes remarkable in a magnifying optical system, optical writing, when making it display. Drawing 5 thru/or drawing 8 are the figures showing a fault in case there are not a sectional view of a 2nd embodiment of this invention, a top view, an explanatory view of operation, and a curved shape section, and the curved shape section 2a of curved shape is formed in face shape of a part where the plate shape component 2 touches the fulcrum member 4 in each figure (see drawing 5 and drawing 6). A method of forming the above-mentioned curved shape section 2a is mentioned later.

When the plate shape component 2 carries out tilt displacement of the above-mentioned curved shape section 2a with electrostatic attraction by arranging this to the plate shape component 2 near the fulcrum member 4, displacement of it centering on the above-mentioned curved shape section 2a is attained at the time of displacement of the plate shape component 2, and it can control that the plate shape component 2 shifts. In other words, positioning of the plate shape component 2 to the fulcrum member 4 becomes easy spontaneously.

Thereby, as shown in drawing 7, the plate shape component 2 controls contacting the side of the bamboo hat shape member 5 at the time of displacement of the plate shape component 2.

On the other hand, as shown in drawing 8, when there is no above-mentioned curved shape section 2a, temporarily, fault, like the plate shape component 2 shifts to a position of the direction of arrow C of a graphic display occurs, reflection performance by it falls, it becomes remarkable generating it of mechanical wear of the fulcrum member 4 and its part, and a mechanical strength falls.

[0064]

Drawing 9 thru/or drawing 12 are a sectional view of a 3rd embodiment of this invention, a top view, and a perspective view showing the example of composition of a fulcrum member, and in each figure the fulcrum member 4, The face shape of the part which touches the plate shape component 2 is cylindrical shape $4a_1$ which is the circular shaped part 4a, and as mentioned above, since it is formed with the above-mentioned silicon oxide film 4f or the above-mentioned silicon nitride film 4g, the mechanical strength is strong. When similarly letting the fulcrum member 4 pass and taking the potential of the plate shape component 2, it is formed with conductive materials, such as various metal membranes.

As shown in drawing 11, the fulcrum member 4 is the above-mentioned cylindrical shape $4a_1$.

However, as shown in drawing 12, form which has 4d of slant-faces $_1$ of 4 d of slant faces in a part near the plate shape component 2 and in which a touch area of the above-mentioned circular shaped part 4a is reduced as much as possible may be sufficient.

Therefore, in a field in contact with the plate shape component 2, the fulcrum member 4 from having the above-mentioned circular shaped part 4a. It becomes possible easily, and carrying out tilt displacement of the plate shape component 2 of plate shape formed with a thin film which combines the reflective means 1 with the surface in the arbitrary directions corresponding to a direction which acts on electrostatic attraction, and constitutes it to them reduces a touch area of the plate shape component 2 and the fulcrum member 4, and it becomes easy [an optical deflection of the biaxial direction].

Drawing 13 thru/or drawing 16 are a sectional view of a 4th embodiment of this invention, a top view, and a perspective view showing an example of composition of a fulcrum member, and in each figure the fulcrum member 4, A fulcrum part which touches the plate shape component 2 is the conical shape part 4b which touches at a point mostly, and as mentioned above, since it is formed with the above-mentioned silicon oxide film 4f or the above-mentioned silicon nitride film 4g, a mechanical strength is strong. When similarly letting the fulcrum member 4 pass and taking potential of the plate shape component 2, it is formed with conductive materials, such as various metal membranes.

As shown in drawing 15, as for the above-mentioned conical shape 4b of the fulcrum member 4, the peak has point form $4b_1$.

However, as shown in drawing 16, in the part near the plate shape component 2, round shape $4b_2$ which has a radius of circle may be sufficient as the neighborhood of the peak.

Therefore, since the fulcrum member 4 is the above-mentioned conical shape part 4b like a graphic display, it can strengthen the mechanical strength by the side of the substrate 3 of the fulcrum part of the fulcrum member 4, and it and displacement of the plate shape component 2, Since it is prescribed by the contact portion 2d with the upper surface of the substrate 3 in the end of the plate shape component 2, a touch area is reduced as much as possible, and the adherence and contact electrification to the substrate 3 of the plate shape component 2 can be controlled.

Similarly, since the fulcrum member 4 has point form in the field in contact with the plate shape component 2, it becomes easy [carrying out tilt displacement of the plate shape component 2 in the arbitrary directions corresponding to the direction which acts on electrostatic attraction].

[0065]
Drawing 17 and drawing 18 are a sectional view of a 5th embodiment of this invention, and a top view, and in the figure the fulcrum member 4, The field of the fulcrum part of the fulcrum member 4 which touches the plate shape component 2 is the rectangular rectangular form part 4c, and as mentioned above, since it is formed with the above-mentioned silicon oxide film 4f or the above-mentioned silicon nitride film 4g, the mechanical strength is strong. When similarly letting the fulcrum member 4 pass and taking the potential of the plate shape component 2, it is formed with conductive materials, such as various metal membranes. Therefore, since the above-mentioned rectangular form part 4c of the fulcrum member 4 which touches the plate shape component 2 is a rectangle, it is stabilized and the tilt displacement of the fulcrum member 4 to the short length direction of the fulcrum member 4, i.e., the tilt displacement by the electrostatic attraction of the plate shape component 2 of 1 shaft orientations, can be caused.
Drawing 19 thru/or drawing 22 are a sectional view of a 6th embodiment of this invention, a top view, and a perspective view showing the example of composition of a fulcrum member, and the fulcrum member 4, The fulcrum part of the fulcrum member 4 which touches the plate shape component 2 is the ridge form part 4e which consists of form of a ridge of having 4d of slant-faces $_2$ of 4 d of the above-mentioned slant faces which touch by a line mostly, and as mentioned above, Since it is formed with the above-mentioned silicon oxide film 4f or the above-mentioned silicon nitride film 4g, the mechanical strength is strong. When similarly letting the fulcrum member 4 pass and taking the potential of the plate shape component 2, it is formed with conductive materials, such as various metal membranes.
As shown in drawing 21, the fulcrum part of the above-mentioned ridge form part 4e of the fulcrum member 4 is linearity-like $4e_1$ which makes a line the peak, but as shown in drawing 22, round shape $4e_2$ which has a radius of circle may be sufficient as the neighborhood of the peak.
Since the fulcrum part of the above-mentioned ridge form part 4e of the fulcrum member 4 which touches the plate shape component 2 has touched by the line mostly, the touch area of the above-mentioned ridge form part 4e of the fulcrum member 4 and the plate shape component 2 is reduced, it is stabilized and the tilt displacement by the electrostatic attraction of the plate shape component 2 of 1 shaft orientations can be caused.
From it being the ridge-like form where the above-mentioned ridge form part 4e of the fulcrum member 4 has 4d of slant-faces $_2$ which is 4d of the above-mentioned slant faces. Since displacement of strength and the plate shape component 2 is prescribed in the mechanical strength of the fulcrum member 4 by the above-mentioned contact portion 2d with the upper surface of the substrate 3 in the end of the plate shape component 2, a touch area is reduced as much as possible, and the adherence and contact electrification to the substrate 3 of the plate shape component 2 can be controlled.
[0066]
In drawing 23 and drawing 24, the electrode 6 for making electrostatic attraction act, Four pieces, electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$, are formed like a graphic display at least two or more pieces on the substrate 3 with which the fulcrum member 4 which counters the back side of the plate shape component 2 was formed, for example, and the plate shape component 2 has floated electrically. As construction material of electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$, when conductivity etc. are taken into consideration, metal, such as aluminum system metal, titanium nitride, and titanium, is desirable.
For example, two or more electrode $6a_1$ formed in the substrate 3 like a graphic display, The electrostatic attraction resulting from the potential difference between four of electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$, A play can be given via [the plate shape component 2] dielectrically between each electrode $6a_1$ of the plate shape component 2 and the electrode 6, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$, and the plate shape component 2 can be displaced in the direction of the purpose.
A displacement direction of the plate shape component 2 is changeable at high speed by impressing arbitrary voltage to each electrode $6a_1$ of the electrode 6 which counters considering fulcrum member 4 ** as a center succeedingly, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$.
Two or more electrode $6a_1$ of each of the electrode 6, electrode $6a_2$, structure and control which can make produce potential difference arbitrarily between electrode $6a_3$ and electrode $6a_4$, are controlled by the biaxial direction with high precision in direction of an inclination of the plate shape component 2 by that cause, and perform an optical deflection are still easier -- it is easy, an operation is stable and a response can also be made still quicker.
In drawing 25 and drawing 26, a light reflex field of the above-mentioned reflector 1a of the reflective means 1 or conductive area 2b of the plate shape component 2 which has conductivity in part at least was formed, and at least a part of above-mentioned conductive area 2b has countered with the electrode 6. As construction material of the above-mentioned conductive area 2b, when conductivity etc. are taken into consideration, metal, such as aluminum system metal, titanium nitride, and titanium, is desirable. When low-cost-izing to serve also as a light reflex field of the above-mentioned reflector 1a of the reflective means 1 with the above-mentioned conductive area 2b, it is desirable for reflection performance to be good and the above-mentioned aluminum system metal 1b is desirable especially in that case.
Two or more two or more pieces formed in the substrate 3 like a graphic display, for example, each electrode $6a_1$ of the electrode 6, The electrostatic attraction resulting from the potential difference between electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$, A play can be given via the above-mentioned conductive area 2b between two or more electrode $6a_1$ of each of the plate shape component 2 and the electrode 6, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$, and the plate shape component 2 can be displaced in the direction of the purpose by lower driver voltage.
The displacement direction of the plate shape component 2 is changeable centering on the fulcrum part of the fulcrum member 4 succeedingly at high speed by impressing arbitrary voltage to each electrode $6a_1$ of the plurality of the electrode 6 which counters, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$.
Between each electrode $6a_1$ of the plurality of the electrode 6 which counters, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$, potential difference can be produced arbitrarily and, thereby, direction of the inclination of the plate shape component 2 can be controlled by the biaxial direction with high precision.
[0067]
A reflective means 1 by which the optical deflection equipment 0 reflects incident light in drawing 27 and drawing 28, The plate

shape component 2 of the plate shape formed with the thin film which combines the reflective means 1 with the surface and constitutes it, The fulcrum member 4 used as the fulcrum at the time of displacement of the inclining plate shape component 2 on the substrate 3 laid without fixing the plate shape component 2, and the substrate 3, Bamboo hat shape member $5a_1$ of the bamboo hat shape member 5 of the bamboo hat form which forms the void (G) where displacement is arranged in the state of freedom in the plate shape component 2 on the fulcrum member 4, Bamboo hat shape member $5a_2$, bamboo hat shape member $5a_3$, and bamboo hat shape member $5a_4$, It consists of electrode $6a_1$ which countered the circumference of the fulcrum member 4 on the substrate 3 with the rear face of the plate shape component 2, and has been arranged, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$ (see drawing 27).

And in the optical deflection equipment 0 the plate shape component 2, Since it does not have a fixed end, the early position Bamboo hat shape member $5a_1$ of the bamboo hat shape member 5 of the fulcrum member 4 top on the substrate 3, and bamboo hat form, Since it is restricted in the void (G) formed between bamboo hat shape member $5a_2$, bamboo hat shape member $5a_3$, and bamboo hat shape member $5a_4$ and displacement is free, The arrangement which keeps away from electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$ most was indicated (see drawing 28).

In drawing 29 and drawing 30, the optical deflection equipment 0 performs a reset action, in order to install the plate shape component 2 on the fulcrum member 4 from an initial state.

In a reset action, electrode $6a_1$, electrode $6a_2$, By [of electrode $6a_3$ and electrode $6a_4$] making potential into electrode $6a_1$=X (V), electrode $6a_2$=0(V), electrode $6a_3$=X/2(V), and electrode $6a_4$=X/2(V), respectively, Electrostatic attraction distribution as shown by the white arrow of the graphic display was acquired, and the size of the white arrow showed the size of electrostatic attraction.

The plate shape component 2 inclines in the direction of arrow M of a graphic display, at least a part of plate shape component 2 2d, for example, the above-mentioned contact portion of the end of the plate shape component 2, contacts the substrate 3, a direction is specified like a graphic display, and a reflected light is obtained in a reset direction.

X(V)s impressed here The plate shape component 2 and each electrode $6a_1$, It is determined by the distance between electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$, electric capacity, etc., and becomes a little larger voltage than voltage Y(V) which causes the inclination centering on displacement of the usual plate shape component 2, i.e., the fulcrum part of the fulcrum member 4.

[0068]

In drawing 31 and drawing 32, next, electrode $6a_1$, electrode $6a_2$, By [of electrode $6a_3$ and electrode $6a_4$] making potential into electrode $6a_1$=Y/2(V), electrode $6a_2$=Y/2(V), electrode $6a_3$=Y(V), and electrode $6a_4$=0(V), respectively, The plate shape component 2 inclines in the direction of arrow N of a graphic display at high speed in a reset direction and a counter direction, and at least a part of plate shape component 2 2d, for example, the above-mentioned contact portion of the end of the plate shape component 2, contacts the substrate 3, it specifies a direction like a graphic display, and performs an optical deflection. That is, the displacement direction of the plate shape component 2 is changeable at high speed by impressing arbitrary voltage to electrode $6a_1$ which counters centering on the fulcrum part of the fulcrum member 4, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$.

In drawing 33 and drawing 34, electrode $6a_1$, electrode $6a_2$, By making potential of electrode $6a_3$ and electrode $6a_4$ into electrode $6a_1$=Y/2(V), electrode $6a_2$=0(V), electrode $6a_3$=Y/2(V), and electrode $6a_4$=Y(V), respectively, The optical deflection (1) of drawing 31 and drawing 32 changes an axis, the plate shape component 2 carries out tilt displacement in the direction of arrow O of a graphic display at high speed, and at least a part of plate shape component 2 2d, for example, the above-mentioned contact portion of the end of the plate shape component 2, contacts the substrate 3, it specifies a direction, and performs an optical deflection (2).

That is, direction of the inclination of the plate shape component 2 is controllable by the biaxial direction with high precision.

As mentioned above, by giving different potential between two or more electrode $6a_1$ of the electrode 6, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$, The plate shape component 2 is displaced with electrostatic attraction, namely, it inclines centering on the fulcrum part of the fulcrum member 4, and the entering light flux can change a reflecting direction.

By [of 4 d of the above-mentioned slant faces which the fulcrum member 4 does not illustrate] contacting the plate shape component 2 in part at least, and performing an optical deflection, a shock at the time of contact can be got in a field, and the shock exerted on the plate shape component 2 can be eased. 4 d of the above-mentioned slant faces which the fulcrum member 4 does not illustrate can prescribe direction of the inclination of the plate shape component 2, and the controllability of an inclination and stability are improved.

[0069]

By giving different potential between the different electrode 6, for example, electrode $6a_1$, and electrode $6a_2$ explains [in / next / drawing 35] the times of a reset action including the effect which has arranged the above-mentioned conductive area 2b for the principle which electrostatic attraction generates on the plate shape component 2 to an example. Positive potential X(V) is impressed to electrode $6a_1$, and 0(V) is impressed to electrode $6a_2$. Although electrostatic attraction occurs between two-electrodes $6a_1$, electrode $6a_2$, and the plate shape component 2 that has floated electrically at this time and the plate shape component 2 is displaced to the electrode side, in electrode $6a_1$, positive charge appears with the positive potential first impressed to electrode $6a_1$. And via a void (G), it is dielectrically generated by the negative charge in the plate shape component 2, and a negative charge spreads efficiently in electric conduction in the above-mentioned conductive area 2b simultaneously in it. Conversely, when it says, the plate shape component 2 is made to generate a negative charge efficiently with the above-mentioned conductive area 2b. Since the plate shape component 2 and the above-mentioned conductive area 2b have floated electrically at this time, in the plate shape component 2 and the above-mentioned conductive area 2b which counter electrode $6a_2$ via a void (G), positive charge spreads typically. Electrode $6a_2$ which a negative charge generates typically is actually grounded by electrode $6a_2$ so that it may correspond to the positive charge, but it becomes such when it thinks typically. Thereby, electrostatic attraction occurs also in the plate shape component 2 located in the electrode $6a_2$ upper part.

Although a series of flows explained the above-mentioned explanation, it does not necessarily happen by a series of flows, and the potential difference of two-electrodes $6a_1$ and electrode $6a_2$ generates those phenomena in synchronization.

The plate shape component 2 and the above-mentioned conductive area 2b which have floated electrically actually serve as electrode $6a_1$ and arbitrary potential between electrode $6a_2$. Arbitrary potential, the electrostatic attraction by the potential difference of electrode $6a_1$, and arbitrary potential and the electrostatic attraction by the potential difference of electrode $6a_2$ will occur.
This arbitrary potential changes with structural factors, such as area of a void (G), and electrode $6a_1$ and electrode $6a_2$. Thus, with the generated electrostatic attraction, the plate shape component 2 is displaced to the electrode $6a_1$ or electrode $6a_2$ side.
[0070]
In drawing 36 and drawing 37, in the optical deflection equipment 0, 4d of slant-faces $_3$ of 4 d of the above-mentioned slant faces of the fulcrum member 4, It has for example, electrode $6a_1$ of at least two or more electrodes 6 for [of the plate shape component 2] being mostly formed corresponding to the whole region, and making electrostatic attraction act on 4d of above-mentioned slant-faces $_3$ of 4 d of the above-mentioned slant faces, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$. As construction material of the fulcrum member 4 which consists of on [of 4 d of the above-mentioned slant faces] above-mentioned 4d of slant-faces $_3$, they are the above-mentioned silicon oxide film 4f or the above-mentioned silicon nitride film 4g similarly.
Like a graphic display, the plate shape component 2 is approached, the electrode 6 can be installed, and thereby more big electrostatic attraction can be generated as the fulcrum part of the fulcrum member 4 is approached. In other words, displacement of the plate shape component 2 is enabled more by the low voltage.
Since it can contact all over electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$ and the plate shape component 2 can be displaced, the shock at the time of contact can be distributed and the mechanical strength of change and degradation decreases further also at the time of long term use. By contacting all over electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$, and displacing the plate shape component 2, control of the displacement direction of the plate shape component 2 becomes easy, an operation is still more stable and a response also becomes still quicker.
In drawing 38 and drawing 39, in the optical deflection equipment 0, the light reflex field of the above-mentioned reflector 1a of the reflective means 1, Or the above-mentioned conductive area 2b of the plate shape component 2 which has conductivity in part at least was formed, and at least a part of above-mentioned conductive area 2b has countered with electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$.
As construction material of the above-mentioned conductive area 2b, when conductivity etc. are taken into consideration, metal, such as aluminum system metal, titanium nitride, and titanium, is desirable.
For example, electrode $6a_1$ of the two or more electrodes 6 formed in the substrate 3, The electrostatic attraction resulting from the potential difference between electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$, A play can be given via the above-mentioned conductive area 2b between for example, electrode $6a_1$ of the plate shape component 2 and the electrode 6, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$, and the plate shape component 2 can be displaced in the direction of the purpose by lower driver voltage.
The displacement direction of the plate shape component 2 is changeable at high speed by impressing arbitrary voltage succeedingly to for example, electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, or electrode $6a_4$ of the electrode 6 which counters considering the fulcrum part of the fulcrum member 4 as a center.
Potential difference can be arbitrarily produced among two or more for example, electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, or electrode $6a_4$ of the electrode 6.
[0071]
In drawing 40 and drawing 41, the optical deflection equipment 0 has the hollow form part 3a of the hollow form formed on the substrate 3, In the arbitrary parts of the above-mentioned hollow form part 3a, and above-mentioned 4d of slant-faces $_4$ of 4 d of the above-mentioned slant faces of the fulcrum member 4, The electrode 6 And for example, electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, Or have electrode $6a_4$ and it has the bamboo hat shape member 5 in the upper part of the flat surface of the above-mentioned substrate 5, And it has the plate shape component 2 in the void (G) constituted by the bamboo hat shape member 5 and the above-mentioned hollow form part 3a, And the part where it has floated electrically and the fulcrum member 4 and the plate shape component 2 contact, i.e., the peak of the fulcrum member 4, becomes depressed from the upper surface of the substrate 3, and the plate shape component 2 is low formed in the form part 3a side.
Although the hollow form part 3a and the fulcrum member 4 are formed by carrying out etching processing of the substrate 3, they may process this for the insulator layer 3c after formation thickly on the substrate 3. The peak of the fulcrum member 4, i.e., the fulcrum part of displacement of the plate shape component 2, can be formed lower than the surface of the substrate 3 at the time of the above-mentioned processing.
Although the manufacturing method of this above-mentioned optical deflection equipment 0 is mentioned later, since the above-mentioned hollow form part 3a of the substrate 3 constitutes the lower part of the void (G) which restricts the movable range of the plate shape component 2, the height of the bamboo hat shape member 5 can be made low.
The bamboo hat shape member 5 gets shocks, such as a collision, in order to stop the plate shape component 2 to a void (G). Therefore, it being important raising a mechanical strength and forming the bamboo hat shape member 5 low will lead to the independence stability of bamboo hat shape member 5 the very thing, and it will raise a mechanical strength by extension.
Yield's improves with the manufacturing method mentioned later, and the void (G) of the optical deflection equipment 0, In order not to be greatly dependent on the rate of flattening of the 1st sacrifice layer 7a that the depth of the above-mentioned hollow form part 3a formed in the substrate 3 and the thickness of the 2nd sacrifice layer 7b that is not illustrated can prescribe, and is not illustrated, However, flattening which results in the substrate 3 was required at least, the controllability of the height of a void (G) could be improved, and the controllability of driver voltage and reset voltage became good.
[0072]
Drawing 42 thru/or drawing 44 are a sectional view of one unit of the optical deflection equipment in which an 11th embodiment of this invention is shown, a top view, and a top view showing a state of aggregation. In each figure, an outside is a circle configuration like a graphic display in the plate shape component 2 in the optical deflection equipment 0 (see drawing 43).
The reflected light reflected in the reflection region of the above-mentioned reflector 1a of the reflective means 1 combined with

the plate shape component 2 becomes circular, since the plate shape component 2 is a circle configuration like a graphic display, 1 pixel in the described image forming device 200 possessing the optical deflection equipment 0 which is not illustrated and described image projection device which is not illustrated 300 grade can be made into a circle configuration. Thereby, dot form can be made dotted with the gap part of an adjacent pixel (see drawing 44). therefore — differing from the gap part of the adjacent pixel of the rectangle picture element shape by the rectangle plate shape component 2 serving as a linear muscle — high — a brilliance picture can be acquired.

In [drawing 45 and drawing 46 are a sectional view of other embodiments, and a top view, and] this optical deflection equipment 0, Bamboo hat shape member $5a_1$, bamboo hat shape member $5a_2$, bamboo hat shape member $5a_3$, and bamboo hat shape member $5a_4$ vacate an interval (g) for the arbitrary parts corresponding to the periphery of the plate shape component 2 in the bamboo hat shape member 5, and are installed in them, for example. [two or more] Since it is possible to start the etching removal of the sacrifice layer 7 which is not illustrated in the manufacturing method of the optical deflection equipment 0 mentioned later from two or more interval (g) parts, the time required at the time of the etching removal of the above-mentioned sacrifice layer 7 which is not illustrated can be shortened.

Since the plate shape component 2 and the substrate 3 are exposed to an etching reagent at the time of etching removal, when the etching time becomes short, improvement in the yield is obtained.

[0073]

Drawing 47 and drawing 48 are a sectional view of a 13th embodiment, and a top view, and the bamboo hat shape member 5 is installed in all the part fields corresponding to a periphery of the plate shape component 2 in the optical deflection equipment 0. The bamboo hat shape member 5 from continuous line arrangement being carried out over the perimeter of the plate shape component 2. The plate shape component 2 overflows from a void (G) which had a movable range restricted mechanically, since it reduces that the optical deflection equipment 0 breaks down as much as possible, also at the time of long term use, an operation is still more stable, there are still less change and degradation, and a mechanical strength can do it.

Next, the bamboo hat shape member 5 in the optical deflection equipment 0 is constituted by the insulator layer 5b which has insulation. As mentioned above, the bamboo hat shape member 5 contacts the plate shape component 2, in order to stop the plate shape component 2 to arbitrary voids (G). Therefore, a danger of changing potential of the plate shape component 2 which has floated electrically the bamboo hat shape member 5 being conductivity is high. That is, even when the plate shape component 2 contacts the bamboo hat shape member 5, since an electric charge of the plate shape component 2 which has floated electrically does not move via the bamboo hat shape member 5, it can control changing potential of the plate shape component 2.

Next, in the optical deflection equipment 0, the bamboo hat shape member 5 is constituted by the translucency film 5c which has translucency to an incoming beam, and is especially constituted by the above-mentioned silicon oxide film 5d. Since the reflected light from a field which laps with the bamboo hat shape member 5 of the light reflex field of the above-mentioned reflector 1a of the reflective means 1 which combines with the plate shape component 2 and is constituted by using the bamboo hat shape member 5 as the above-mentioned translucency film 5c can also make it contribute, The area of the reflected light in one element and light volume can be made to increase. that is, since ON light volume increases, the structure and control which perform an optical deflection are still easier — it is easy, an operation is still more stable, a response is also still quicker, and it can carry out

In the manufacturing method of the optical deflection equipment 0 which can provide the bamboo hat shape member 5 which was compatible in high insulation and high translucency by using the bamboo hat shape member 5 as the above-mentioned silicon oxide film 5d, and is mentioned later, it becomes producible [a miniaturization and integration] and structure and control are still easier — it is easy and an operation is still more stable, a response is also still quicker, and a miniaturization and integration are still more possible for it, and it can perform low cost-ization further.

[0074]

Next, the bamboo hat shape member 5 in the optical deflection equipment 0 is constituted by the shading film 5e which has a light sheilding to an incoming beam, and is especially constituted by the chromium oxide film 5f. By using the bamboo hat shape member 5 as the above-mentioned shading film 5e, a reflection in the direction which is not expected the light flux which entered into the bamboo hat shape member 5 can be controlled. Thereby, the stray light of the optical deflection to a target direction can be reduced. since the stray light is an ingredient produced also when the optical deflection to the target direction is not being performed, it is still simpler for the structure and control which OFF light volume is controlled and perform an optical deflection — it is easy and an operation becomes still more stable.

In the manufacturing method of the optical deflection equipment 0 which can provide the bamboo hat shape member 5 which was compatible in high insulation and a high light sheilding by using the bamboo hat shape member 5 as the above-mentioned chromium oxide film 5f, and is mentioned later, the structure and control which become producible [a miniaturization and integration] and perform an optical deflection are still easier — it is easy, an operation is still more stable, and a response is also still quicker, and also it becomes low cost.

Next, the plate shape component 2 is constituted by the silicon nitride film 2c in the optical deflection equipment 0, And it is constituted by the above-mentioned aluminum system metal membrane 1b which the light reflex field of the above-mentioned reflector 1a of the reflective means 1 which combines with the plate shape component 2 and is constituted has high conductivity, and has high reflexibility.

The plate shape component 2 of the above-mentioned silicon nitride film 2c has high dielectric breakdown voltage, And since the tolerance over long-term degradation, i.e., the fatigue accompanying repetition displacement, is also high, a light weight and the drive [in /-izing can be carried out / thin film / and / frequency high by that cause] of not less than several 10-kHz high-speed operation are attained possible as much as possible.

By using the light reflex field of the above-mentioned reflector 1a of the reflective means 1 as the above-mentioned aluminum system metal membrane 1b which is compatible in high reflection performance and high conductivity, It can serve with the above-mentioned conductive area 2b, and thereby, optical deflection operation of the optical deflection equipment 0, i.e., displacement of the plate shape component 2, can be performed by the low voltage, obtaining higher reflected light quantity.

[0075]

In drawing 49 and drawing 50, the optical deflection equipment 0 can be used for the latent image formation means 202 grade in the described image forming device 200 which is not illustrated which is not illustrated as the one-dimensional optical deflection array 10 which arranged plurality to the one-dimensional array configuration (see drawing 49). It can be used for the optical

switch means 301 grade in the described image projection display device 300 which is not illustrated as the two-dimensional optical deflection array 20 arranged to the two-dimensional array configuration, combining the above-mentioned one-dimensional optical deflection array 10 two or more (see drawing 50).

[0076]

In drawing 51 thru/or drawing 59, the optical deflection equipment 0, The fulcrum member 4 and the electrode 6 two or more on the substrate 3 as follows For example, electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, Or the plate shape component 2 of the plate shape formed with the thin film which combines the reflective means 1 with the surface and constitutes it via the 1st sacrifice layer 7a of the above that formed electrode $6a_4$, and deposited and carried out flattening is formed, After patternizing the bamboo hat shape member 5 to the position which patternized the 2nd deposited sacrifice layer 7b of the above, Since etching removes the 1st sacrifice layer 7a of the above, and the 2nd sacrifice layer 7b of the above, the reflecting direction of incident light One axis, or the structure and control which change in the biaxial direction and perform an optical deflection are easy -- a response being also quick, change and degradation having few mechanical strengths also at the time of long term use, and driver voltage being [it is easy and an operation is stable,] low, without restricting the wavelength of the incident light to be used, and with saving resources. A miniaturization and integration can be possible and the manufacturing method of the optical deflection equipment 0 with which an operating environment is not restricted by low cost, either can be provided now.

In a substrate upper fulcrum component formation process (a_1), on the substrate 3 of the silicon substrate 3b which has the above-mentioned (100) plane direction, The above-mentioned silicon oxide film 4f which constitutes the fulcrum member 4 accumulates with plasma CVD method, and after that with the photo-engraving process using the photo mask in which the pattern which has area gradation was formed, or the photo-engraving process which carries out resist pattern formation post heating modification. The resist pattern which has the form and the thickness with the almost arbitrary shape of isomorphism of the fulcrum member 4 is formed, and the purpose-shaped fulcrum member 4 is formed by the technique of the dry etching method after that.

An about 2-micrometer silicon oxide film may be formed on the silicon substrate 3b which has the above-mentioned (100) plane direction, and processing same in about 1 micrometer of the upper layer may be performed.

The height in the peak of the fulcrum part of the fulcrum member 4 is about 1 micrometer (see drawing 51).

[0077]

In an electrode formation process (a_2), for example, electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, or electrode $6a_4$ is formed with the thin film of a titanium nitride (TiN) film. [the electrode 6]

A TiN film by the DC magnetron sputtering method which targeted Ti. Membranes were formed in thickness of 0.01 micrometer, and it patternized with the photo-engraving process and the technique of the dry etching method as for example, two or more electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$ (see drawing 52).

In the protection film formation process (a_3), for example, the silicon nitride film by plasma CVD method was formed by 0.2 micrometer of thickness as the protective film 6b of electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, or electrode $6a_4$ (see drawing 53). [the electrode 6]

In the 1st sacrifice layer formation process (a_4), 2 micrometers of amorphous silicone films were made to deposit by a sputtering method, and flattening was carried out by processing time control using CMP technology. At this time, the thickness of the amorphous silicon film which remains on the peak of the fulcrum member 4 was processed in time to be set to 0.1 micrometer. The amorphous silicon film which remains is the 1st sacrifice layer 7a of the above.

As the 1st sacrifice layer 7a of the above, besides the above-mentioned film, a polyimide film and a photosensitive organic layer, A resist film, a polycrystalline silicon film, etc. which are generally used in a semiconductor process can also be used, and the reflow method by heat treatment and the etchback method by dry etching can also be used as the technique of flattening (see drawing 54).

The above-mentioned silicon nitride film 2c used as the plate shape component 2 is made to deposit at 0.2 micrometer in thickness with plasma CVD method in a reflective means and a plate shape component formation process (a_5), Then, the above-mentioned aluminum system metal membrane 1b used as the above-mentioned conductive area 2b which serves as the light reflex field of the above-mentioned reflector 1a of the reflective means 1 was made to deposit by sputtering technology by a thickness of 0.05 micrometer. Then, the above-mentioned conductive area 2b and the plate shape component 2 were patternized by the photo-engraving process and the dry etching method, respectively (see drawing 55).

[0078]

In the 2nd sacrifice layer formation process (a_6), 1 micrometer of amorphous silicone films were made to deposit by a sputtering method, and it was considered as the 2nd sacrifice layer 7b of the above. As the 2nd sacrifice layer 7b of the above, a polyimide film, a photosensitive organic layer, a resist film, a polycrystalline silicon film that are generally used in a semiconductor process, etc. can also be used besides the above-mentioned film (see drawing 56).

In order to arrange the bamboo hat shape member 5 which is not illustrated around the plate shape component 2 which separates the optical deflection equipment 0 individually, and combines and constitutes the reflective means 1 in a bamboo hat shape member patternizing process (a_7), It patternized a little more widely than the plate shape component 2 which combines the reflective means 1 simultaneously and constitutes the 1st sacrifice layer 7a of the above, and the 2nd sacrifice layer 7b of the above by photo-engraving process and the dry etching method (see drawing 57).

In the bamboo hat shape member formation process (a_8), the above-mentioned silicon oxide film 5d which constitutes the bamboo hat shape member 5 was made to deposit at 0.8 micrometer in thickness with plasma CVD method, by the photo-engraving process and the dry etching method, it patternized and the bamboo hat shape member 5 was formed. The bamboo hat shape member 5 cannot stop at form like a graphic display, but can also take drawing 60 or form which is illustrated to drawing 61 (see drawing 58).

The 1st sacrifice layer 7a of the above that remains in a sacrifice layer removal process (a_9), And etching removal of the 2nd sacrifice layer 7b of the above is carried out through an opening by wet etching technology, the plate shape component 2 which combines and constitutes the reflective means 1 is arranged to the void (G) where the movable range was restricted, and the optical deflection equipment 0 is completed.

Plurality corresponding to the periphery of the plate shape component 2 for example, [the bamboo hat shape member 5] By vacating a predetermined interval (g) and arranging each bamboo hat shape member $5a_1$, bamboo hat shape member $5a_2$, bamboo

hat shape member $5a_3$, and bamboo hat shape member $5a_4$, Since the 1st sacrifice layer 7a of the above of the above-mentioned sacrifice layer 7 and the 2nd sacrifice layer 7b of the above are exposed to an interval (g) part in three dimensions, etching can be completed more in a short time (see drawing 59).

[0079]

Drawing 62 thru/or drawing 71 are shown figures the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention, and the optical deflection equipment 0, As follows the fulcrum member 4 and the electrode 6 two or more on the substrate 3 For example, electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, Or electrode $6a_4$ is formed, Form the plate shape component 2 which consists of the above-mentioned curved shape section 2a of the curved shape formed with the thin film which combines the reflective means 1 with the surface and constitutes it via the 3rd sacrifice layer 7c that the fulcrum member 4 was made to project and was deposited, was deposited on the 1st sacrifice layer 7a of the above that carried out flattening in piles, and carried out flattening to it, and further, After patternizing the bamboo hat shape member 5 to the position which patternized the 2nd deposited sacrifice layer 7b of the above, Since etching removes the 1st sacrifice layer 7a of the above of the above-mentioned sacrifice layer 7, the 2nd sacrifice layer 7b of the above, and the 3rd sacrifice layer 7c of the above, If it controls and puts in another way that a center and ****** become possible about the above-mentioned curved shape section 2a at the time of displacement of the plate shape component 2, and the plate shape component 2 shifts when the plate shape component 2 carries out tilt displacement with electrostatic attraction, Positioning of the plate shape component 2 to the fulcrum member 4 becomes easy spontaneously, and it controls that the plate shape component 2 contacts the side of the bamboo hat shape member 5 at the time of displacement of the plate shape component 2, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy — it being easy, an operation being still more stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had still few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the manufacturing method of the optical deflection equipment 0 with which an operating environment is not restricted by low cost, either.

In a substrate upper fulcrum component formation process (b_1), on the substrate 3 of the silicon substrate 3b which has the above-mentioned (100) plane direction, The above-mentioned silicon oxide film 4f which constitutes the fulcrum member 4 accumulates with plasma CVD method, and after that with the photo-engraving process using the photo mask in which the pattern which has area gradation was formed, or the photo-engraving process which carries out resist pattern formation post heating modification. The resist pattern which has the form and the thickness with the almost arbitrary shape of isomorphism of the fulcrum member 4 is formed, and the purpose-shaped fulcrum member 4 is formed by the technique of the dry etching method after that.

An about 2-micrometer silicon oxide film may be formed on the silicon substrate 3b which has the above-mentioned (100) plane direction, and processing same in about 1 micrometer of the upper layer may be performed.

The height in the peak of the fulcrum part of the fulcrum member 4 is about 1 micrometer (see drawing 62).

[0080]

In an electrode formation process (b_2), for example, electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, or electrode $6a_4$ is formed with the thin film of a titanium nitride (TiN) film. [the electrode 6]

A TiN film by the DC magnetron sputtering method which targeted Ti. Membranes were formed in thickness of 0.01 micrometer, and it patternized with a photo-engraving process and the technique of the dry etching method as for example, two or more electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$ (see drawing 63).

In a protection film formation process (b_3), the electrode 6 two or more For example, electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, Or a silicon nitride film by plasma CVD method was formed by 0.2 micrometer of thickness as the above-mentioned protective film 6b of electrode $6a_4$ (see drawing 64).

In the 1st sacrifice layer formation process (b_4), 2 micrometers of amorphous silicone films were made to deposit by a sputtering method, the fulcrum member 4 was exposed using CMP technology, further, time was made to exceed and flattening was carried out. At this time, by considering it as polishing selectivity high CMP conditions with the fulcrum member 4 and the above-mentioned protective film 6b, a fulcrum part remains near the peak of the fulcrum member 4, and an amorphous silicon film remains a little low. A fulcrum part of the fulcrum member 4 projected about 0.2 micrometer. An amorphous silicon film which remains is the 1st sacrifice layer 7a of the above. As the 1st sacrifice layer 7a of the above, besides the above-mentioned film, a polyimide film and a photosensitive organic layer, A resist film, a polycrystalline silicon film, etc. which are generally used in a semiconductor process can also be used, and the etchback method by dry etching can also be used as the technique of flattening (see drawing 65).

[0081]

In the 3rd sacrifice layer formation process (b_5), 0.1 micrometer of amorphous silicone films were made to deposit by a sputtering method, and it was considered as the 3rd sacrifice layer 7c of the above (see drawing 66).

The above-mentioned silicon nitride film 2c used as the plate shape component 2 is made to deposit at 0.2 micrometer in thickness with plasma CVD method in a reflective means and a plate shape component formation process (b_6), Then, the above-mentioned aluminum system metal membrane 1b used as the above-mentioned conductive area 2b which serves as the light reflex field of the above-mentioned reflector 1a of the reflective means 1 was made to deposit by sputtering technology by a thickness of 0.05 micrometer. Then, the above-mentioned conductive area 2b and the plate shape component 2 were patternized by the photo-engraving process and the dry etching method, respectively (see drawing 67).

In the 2nd sacrifice layer formation process (b_7), 1 micrometer of amorphous silicone films were made to deposit by a sputtering method, and it was considered as the 2nd sacrifice layer 7b of the above. As the 2nd sacrifice layer 7b of the above, a polyimide film, a photosensitive organic layer, a resist film, a polycrystalline silicon film that are generally used in a semiconductor process, etc. can also be used besides the above-mentioned film (see drawing 68).

In order to arrange the bamboo hat shape member 5 which is not illustrated around the plate shape component 2 which separates the optical deflection equipment 0 individually, and combines and constitutes the reflective means 1 in a bamboo hat shape member patternizing process (b_8), It patternized a little more widely than the plate shape component 2 which combines the reflective means 1 simultaneously and constitutes the 1st sacrifice layer 7a of the above and the 2nd sacrifice layer 7b of the above, and the 3rd sacrifice layer 7c of the above by the photo-engraving process and the dry etching method (see drawing 69).

In the bamboo hat shape member formation process (b_9), the above-mentioned silicon oxide film 5d which constitutes the bamboo hat shape member 5 was made to deposit at 0.8 micrometer in thickness with plasma CVD method, by the photo-engraving process and the dry etching method, it patternized and the bamboo hat shape member 5 was formed. The bamboo hat shape member 5 cannot stop at form like a graphic display, but can also take drawing 60 or form which is illustrated to drawing 61 (see drawing 70).

The 1st sacrifice layer 7a of the above that remains in a sacrifice layer removal process (b_{10}), Etching removal of the 2nd sacrifice layer 7b of the above and the 3rd sacrifice layer 7c of the above is carried out through an opening by wet etching technology, the plate shape component 2 which combines and constitutes the reflective means 1 is arranged to the void (G) where the movable range was restricted, and the optical deflection equipment 0 is completed. Plurality corresponding to the periphery of the plate shape component 2 for example, [the bamboo hat shape member 5] By vacating a predetermined interval (g) and arranging each bamboo hat shape member $5a_1$, bamboo hat shape member $5a_2$, bamboo hat shape member $5a_3$, and bamboo hat shape member $5a_4$, Since the 1st sacrifice layer 7a of the above of the above-mentioned sacrifice layer 7, the 2nd sacrifice layer 7b of the above, and the 3rd sacrifice layer 7c of the above are exposed to an interval (g) part in three dimensions, etching can be completed more in a short time (see drawing 71).

[0082]

Drawing 72 thru/or drawing 80 are shown figures the manufacture procedure of the optical deflection equipment concerning the embodiment of further others of this invention, and this optical deflection equipment 0, The fulcrum member 4 and the electrode 6 which consist of 4d of slant-faces $_4$ of 4 d of the above-mentioned slant faces in the above-mentioned hollow form part 3a and the above-mentioned hollow form part 3a on the substrate 3 as follows two or more, For example, electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, Or the plate shape component 2 of the plate shape formed with the thin film which combines the reflective means 1 with the surface and constitutes it via the 1st sacrifice layer 7a of the above that formed electrode $6a_4$, and deposited and carried out flattening is formed, After patternizing the bamboo hat shape member 5 to the position which patternized the 2nd deposited sacrifice layer 7b of the above, Since etching removes the 1st sacrifice layer 7a of the above, and the 2nd sacrifice layer 7b of the above, The height of the bamboo hat shape member 5 becomes low, leads to the independence stability of bamboo hat shape member 5 the very thing, and the reflecting direction of incident light One axis, or the structure and control which change in the biaxial direction and perform an optical deflection are easy — it being easy and an operation being stable, a response being also quick, change and degradation having still few mechanical strengths also at the time of long term use, driver voltage being low, without restricting the wavelength of the incident light to be used, and a miniaturization and integration being possible with saving resources, and by low cost. The manufacturing method of the optical deflection equipment 0 with which an operating environment is not restricted, either can be provided now.

With the photo-engraving process using the photo mask which formed the pattern which has area gradation and concentration gradation in the substrate top hollow form part and the fulcrum member formation process (c_1) on the substrate 3 of the silicon substrate 3b which has the above-mentioned (100) plane direction. The resist pattern which has the above-mentioned hollow form part 3a, and the form and the thickness with the almost arbitrary shape of isomorphism of the fulcrum member 4 is formed, and etching processing of the substrate 3 top of the silicon substrate 3b which has the above-mentioned (100) plane direction with the technique of the dry etching method is carried out after that. Then, in order to take insulation with the substrate 3 of the silicon substrate 3b which has the above-mentioned (100) plane direction, the above-mentioned silicon oxide film 4f which constitutes the fulcrum member 4 is made to deposit with about 1-micrometer plasma CVD method. Of the above process, the purpose-shaped above-mentioned hollow form part 3a and the fulcrum member 4 are formed.

An about 2-micrometer silicon oxide film may be formed on the silicon substrate 3b which has the above-mentioned (100) plane direction, and processing same in about 1 micrometer of the upper layer may be performed. The maximum depth of the above-mentioned hollow form part 3a is about 3 micrometers, and the depth in the peak of the fulcrum part of the fulcrum member 4 is about 0.3 micrometer (see drawing 72).

[0083]

In an electrode formation process (c_2), for example, electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, or electrode $6a_4$ is formed with the thin film of a titanium nitride (TiN) film. [the electrode 6] A TiN film by the DC magnetron sputtering method which targeted Ti. Membranes were formed in thickness of 0.01 micrometer, and it patternized with the photo-engraving process and the technique of the dry etching method as for example, two or more electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, and electrode $6a_4$ (see drawing 73).

In a protection film formation process (c_3), the electrode 6 two or more For example, electrode $6a_1$, electrode $6a_2$, electrode $6a_3$, Or the silicon nitride film by plasma CVD method was formed by 0.2 micrometer of thickness as the above-mentioned protective film 6b of electrode $6a_4$ (see drawing 74).

In the 1st sacrifice layer formation process (c_4), 2 micrometers of amorphous silicone films were made to deposit with plasma CVD method, the substrate 3 and the above-mentioned protective film 6b of the silicon substrate 3b which has the above-mentioned (100) plane direction using CMP technology were ground as an etching stop layer, and flattening was carried out.

At this time, an amorphous silicone film in the above-mentioned hollow form part 3a has high controllability by an effect of this etching stop layer, without producing most exaggerated polishes, and flattening is possible.

Thickness of an amorphous silicon film which remains on the peak of a fulcrum part of the fulcrum member 4 was set to about 0.2 micrometer. An amorphous silicon film which remains in the above-mentioned hollow form part 3a is the 1st sacrifice layer 7a of the above. As the 1st sacrifice layer 7a of the above, besides the above-mentioned film, a polyimide film and a photosensitive organic layer, A resist film, a polycrystalline silicon film, etc. which are generally used in a semiconductor process can also be used, and the reflow method by heat treatment and the etchback method by dry etching can also be used as the technique of flattening (see drawing 75).

The above-mentioned silicon nitride film 2c used as the plate shape component 2 is made to deposit at 0.2 micrometer in thickness with plasma CVD method in a reflective means and a plate shape component formation process (c_5), Then, the above-mentioned aluminum system metal membrane 1b used as the above-mentioned conductive area 2b which serves as the light reflex field of the above-mentioned reflector 1a of the reflective means 1 was made to deposit by sputtering technology by a thickness of 0.05 micrometer. Then, the above-mentioned conductive area 2b and the plate shape component 2 were patternized by the photo-engraving process and the dry etching method, respectively (see drawing 76).

[0084]
In the 2nd sacrifice layer formation process (c_6), 1 micrometer of amorphous silicone films were made to deposit by a sputtering method, and it was considered as the 2nd sacrifice layer 7b of the above. As the 2nd sacrifice layer 7b of the above, a polyimide film, a photosensitive organic layer, a resist film, a polycrystalline silicon film that are generally used in a semiconductor process, etc. can also be used besides the above-mentioned film (see drawing 77).
In order to arrange the bamboo hat shape member 5 which is not illustrated around the plate shape component 2 which separates the optical deflection equipment 0 individually, and combines and constitutes the reflective means 1 in a bamboo hat shape member patternizing process (c_7), It patternized a little more widely than the plate shape component 2 which combines the reflective means 1 simultaneously and constitutes the 1st sacrifice layer 7a of the above, and the 2nd sacrifice layer 7b of the above by photo-engraving process and the dry etching method (see drawing 78).
In a bamboo hat shape member formation process (c_8), the above-mentioned silicon oxide film 5d which constitutes the bamboo hat shape member 5 was made to deposit at 0.8 micrometer in thickness with plasma CVD method, by photo-engraving process and the dry etching method, it patternized and the bamboo hat shape member 5 was formed. The bamboo hat shape member 5 cannot stop at form like a graphic display, but can also take drawing 60 or form which is illustrated to drawing 61 (see drawing 79).
The 1st sacrifice layer 7a of the above that remains in a sacrifice layer removal process (c_9), And etching removal of the 2nd sacrifice layer 7b of the above is carried out through an opening by wet etching technology, the plate shape component 2 which combines and constitutes the reflective means 1 is arranged to a void (G) where a movable range was restricted, and the optical deflection equipment 0 is completed.
Plurality corresponding to a periphery of the plate shape component 2 for example, [the bamboo hat shape member 5] By vacating a predetermined interval (g) and arranging each bamboo hat shape member $5a_1$, bamboo hat shape member $5a_2$, bamboo hat shape member $5a_3$, and bamboo hat shape member $5a_4$, Since the 1st sacrifice layer 7a of the above of the above-mentioned sacrifice layer 7 and the 2nd sacrifice layer 7b of the above are exposed to an interval (g) part, etching can be completed more in a short time (see drawing 80).
[0085]
The described image forming device 200 which performs optical writing by an electrophotography process and forms a picture in drawing 81, A photo conductor of drum shape of the picture support 201 which is held rotatable in the arrow (V) direction of a graphic display, and supports a formed image, A photo conductor top of drum shape of the described image support 201 uniformly electrified in the electrifying means 205, Perform optical writing by the above-mentioned latent image formation means 202 which consists of the above-mentioned optical information processing device 100 which consists of an independent drive means 101 to drive respectively two or more optical deflection equipment 0 of each of the above-mentioned one-dimensional optical deflection array 10 independently, and a latent image is formed, Develop a latent image formed by each optical deflection equipment 0 of the above-mentioned one-dimensional optical deflection array 10 of the above-mentioned latent image formation means 202 by the developing means 203, and a toner image is formed, After a toner image which transferred a toner image formed by the above-mentioned developing means 203 to a transfer paper of a transferred object (P) by the transfer means 204, and was transferred by transfer paper of a transferred object (P) is established by the fixing means 206, a transfer paper of a transferred object (P) is delivered to the delivery tray 207, and it is stored.
On the other hand, the photo conductor of the drum shape of the described image support 201 after transferring a toner image to the transfer paper of a transferred object (P) by the above-mentioned transfer means 204 is cleaned by the cleaning means 208, and prepares for the image formation of a next step.
[0086]
The above-mentioned optical information processing device 100 in the above-mentioned latent image formation means 202, The incoming beam (R) from the light source 102 via the 1st lens system 103, Two or more optical deflection equipment 0 of each of the above-mentioned one-dimensional optical deflection array 10 glares, and two or more above-mentioned light modulation devices 0 of each of the above-mentioned one-dimensional optical deflection array 10, The plate shape component 2 of the plate shape formed with the thin film which combines with the surface a reflective means 1 to reflect each incident light independently according to picture information, and constitutes it by the above-mentioned independent drive means 101, Displacement arranges in the state of freedom in the void (G) formed between the bamboo hat-shaped bamboo hat shape members 5 the fulcrum member 4 top on the substrate 3 without fixing on the substrate 3, Potential is given to the electrode 6 which countered the circumference of the fulcrum member 4 on the substrate 3 with the plate shape component 2, and has been arranged, Change the reflecting direction of incident light by the reflective means 1 on the plate shape component 2 inclined and laid on the fulcrum member 4, and an optical deflection is performed, structure and control are easy for the surface on the photo conductor of the drum shape of the described image support 201 through the 2nd lens system 104 through the reflective means 1 in an incoming beam (R) -- it is easy, and image formation of the reflected light from the adjacent elements generated when the stray light and a reflecting direction are in disorder is controlled and carried out.
The above-mentioned one-dimensional optical deflection array 10 was formed in the above-mentioned manufacturing method and the similar way by using a silicon wafer as a substrate.
therefore, control of ON, OFF, etc. at the time of the structure and the optical writing which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection is easy -- it being easy and, And the reflected light from the adjacent elements generated when the stray light and a reflecting direction are in disorder can be controlled, Driver voltage low [an operation is stable and / a response is also quick, and / change and degradation have few mechanical strengths also at the time of long term use, and], without restricting the wavelength of the incident light to be used with saving resources. a miniaturization and integration are possible, the optical deflection equipment 0 with which an operating environment is not restricted by low cost, either is provided, and structure and control are easy -- it being easy and, And the above-mentioned optical information processing device 100 possessing the optical deflection equipment 0 which controls the reflected light from the adjacent elements generated when the stray light and a reflecting direction are in disorder, and the ON/OFF control at the time of optical writing are good, and high-speed operation is possible, and the high speed which long-term reliability is high and drives by the low voltage and whose S/N ratio can also improve -- high -- the described image forming device 200 which forms a brilliance picture can be provided now.
[0087]

The described image projection display device 300 which projects and displays a picture in drawing 82, . Change the reflecting direction of the incoming beam (R) of projection picture data, perform an optical deflection, and project a picture. Each above-mentioned light modulation device 0 of the optical switch means 301 which consists of the above-mentioned optical information processing device 100 which consists of an above-mentioned independent drive means 101 to drive respectively two or more optical deflection equipment 0 of each of the above-mentioned two-dimensional optical deflection array 20 independently projects a picture on the projection screen 302, and displays it.
The above-mentioned optical information processing device 100 in the above-mentioned optical switch means 301, Two or more optical deflection equipment 0 of each arranged by the above-mentioned two-dimensional deviation array 20 is irradiated with the incoming beam (R) from the above-mentioned light source 102, It reflects by the reflective means 1 which combined the data of the desired picture with each plate shape component 2 by the above-mentioned independent drive means 101, and was constituted, control of the display of structure and image projection data, i.e., ON, OFF, etc. at the time of the light and darkness of a pixel, is easy for the above-mentioned projection screen 302 via the projection lens 105 and the diaphragm 106 — it is easy, and the reflected light from the adjacent elements generated when the stray light and a reflecting direction are in disorder is controlled and projected.
In order to perform a colored presentation, the rotary collar hole 107 can be formed in front of the above-mentioned light source 102, and the microlens array 108 can also be used for improved efficiency.
The above-mentioned two-dimensional optical deflection array 20 was formed in the above-mentioned manufacturing method and the similar way by using a silicon wafer as a substrate.
therefore, control of the display of the structure of changing the reflecting direction of incident light in one axis or the biaxial direction, and performing an optical deflection, and image projection data, i.e., ON, OFF, etc. at the time of the light and darkness of a pixel, is easy -- it being easy and, And the reflected light from the adjacent elements generated when the stray light and a reflecting direction are in disorder can be controlled, Driver voltage low [an operation is stable and / a response is also quick, and / change and degradation have few mechanical strengths also at the time of long term use, and], without restricting the wavelength of the incident light to be used with saving resources. a miniaturization and integration are possible, the optical deflection equipment 0 with which an operating environment is not restricted by low cost, either is provided, and structure and control are easy — it being easy and, And the above-mentioned optical information processing device 100 which controls the reflected light from the adjacent elements generated when the stray light and a reflecting direction are in disorder, and the ON/OFF control at the time of light-and-darkness control of a picture are good, and high-speed operation is possible, And since long-term reliability was high, it drove by the low voltage and the contrast ratio also improved, though it was high-intensity, the described image projection display device 300 which projects and displays the high definition picture which has high contrast could be provided.
[0088]
The optical transmission device 400 which determines the optical path of a lightwave signal, and outputs and transmits it in drawing 83. The reflecting direction of the incident light of the lightwave signal from the lightwave signal input means 401 which inputs a lightwave signal, and the above-mentioned lightwave signal input means 401 One axis, Or the optical switch means 402 which consists of the optical deflection equipment 0 of the above-mentioned two-dimensional optical deflection array 20 which changes in the biaxial direction, performs an optical deflection, and determines the optical path of each lightwave signal, It consists of the lightwave signal output means 403 which outputs the lightwave signal from the above-mentioned optical switch means 402, and the optical path of a lightwave signal is determined and outputted and is transmitted.
One piece in which the above-mentioned lightwave signal input means 401 has the above-mentioned optical switch means 402, Or two or more signal input transfer ports 401a, for example, signal input transfer port $401a_1$, The light information signal inputted from signal input transfer port $401a_2$ and signal input transfer port $401a_3$, With two or more optical deflection equipment 0 of each arranged by the two-dimensional optical deflection array 20a of each above-mentioned two-dimensional optical deflection array 20 arranged in two steps, and the two-dimensional optical deflection array 20b, one axis, Deviate in the biaxial direction, choose and determine a predetermined output port, and Or two or more signal output transfer ports 403a, For example, it outputs from the above-mentioned lightwave signal output means 403 which has signal output transfer port $403a_1$, signal output transfer port $403a_2$, and signal output transfer port $403a_3$, control of the selection etc. which determine the port of structure and an outputted ray information signal is easy -- it is easy, and the reflected light from the adjacent elements generated when the stray light and a reflecting direction are in disorder is controlled and transmitted.
Although the above-mentioned optical switch means 402 has arranged the above-mentioned two-dimensional optical deflection array 20 to two steps and the large optical deflection angle is taken, the number of the above-mentioned two-dimensional optical deflection arrays 20 may be one by the number of connections etc. to choose.
. Were arranged by the two-dimensional optical deflection array 20a of each above-mentioned two-dimensional optical deflection array 20, and the two-dimensional optical deflection array 20b. Each control device $402a_1$ of the control device 402a for carrying out drive controlling being simultaneous and independently and each control device $402a_1$ possess two or more optical deflection equipment 0 of each, respectively.
therefore, control of the selection etc. which determine the port of the structure of changing the reflecting direction of incident light in one axis or the biaxial direction, and performing an optical deflection, and an outputted ray information signal is easy -- it being easy and, And the reflected light from the adjacent elements generated when the stray light and a reflecting direction are in disorder can be controlled, Driver voltage low [an operation is stable and / a response is also quick, and / change and degradation have few mechanical strengths also at the time of long term use, and], without restricting the wavelength of the incident light to be used with saving resources. a miniaturization and integration are possible, the optical deflection equipment 0 with which an operating environment is not restricted by low cost, either is provided, and structure and control are easy — it being easy and, And can control the reflected light from the adjacent elements generated when the stray light and a reflecting direction are in disorder, and can perform the optical deflection of the biaxial direction correctly easily, and control of selection of each port is good, control the stray light to an adjacent port, and high-speed optical path switching is possible, Since long-term reliability was high, it drove by the low voltage and integration was completed on the same board, though it was small, the above-mentioned optical transmission device 400 which determines the optical path of a lightwave signal with little malfunction, and outputs and transmits it at high speed could be provided.
[0089]

Drawing 84 is a top view for explaining the principal part of the optical deflection equipment in which a 16th embodiment of this invention is shown.
Drawing 85 is an A-A' line sectional view of drawing 84.
In the figure, the fulcrum member 4 is pyramid form which the fulcrum part which touches the plate shape component 2 touches at a point mostly, and as mentioned above, since it is formed with the above-mentioned silicon oxide film or the above-mentioned silicon nitride film, the mechanical strength is strong. Although the crowning may be sharp, if the point is made hemispherical, stress concentration can weaken.
[0090]
Drawing 86 is a top view for explaining the principal part of the optical deflection equipment in which a 17th embodiment of this invention is shown.
Drawing 87 is an A-A' line sectional view of drawing 86.
In a figure, although the fulcrum part of the fulcrum member 4 which touches the plate shape component 2 is the same as that of the above at the point which is the pyramid form which touches at a point mostly, a different point is a point which has a size whose size of the bottom of a pyramid is almost comparable as the plate shape component 2. Therefore, when the plate shape component 2 inclines in response to electrostatic force, the rear face of the plate shape component 2 is close to one of four slant faces of the fulcrum member 4, and maintains the dramatically stable position.
[0091]
Drawing 88 is a top view for explaining the principal part of the optical deflection equipment in which an 18th embodiment of this invention is shown.
In a figure, mark $6a_1$ thru/or $6a_8$ show eight electrodes.
As for the optical deflection equipment 0, the outside and the plate shape component 2 are circularly constituted like the embodiment shown in drawing 43. The fulcrum member 4 is formed in eight-sided pyramids in this embodiment. Eight electrode $6a_1$ - $6a_8$ are provided corresponding to each slant face of eight-sided pyramids, and are insulated mutually. Temporarily now by considering it as electrode $6a_1$ - $6a_5$=Y/2(V), electrode $6a_6$=Y(V), $6a_7$=Y/2(V), and electrode $6a_8$=0(V), Although it is pulled to the electrostatic attraction committed between electrode $6a_6$ and the plate shape component 2 and between the plate shape component 2 and electrode $6a_8$, since the plate shape component 2 has another slant face in both middle, it inclines in the electrode $6a_7$ side.
[0092]
If the size of the bottom of eight-sided pyramids is made almost equal to the size of the plate shape component 2, the rear face of the plate shape component 2 will carry out contact adhesion at an inclined part, and the reflecting direction of light will be stabilized. Although the bamboo hat shape member 5 is formed in the perimeter of the circular substrate in drawing 43, it is discretely provided in four places in this embodiment. Whether it is better to use which should just determine on account of the composition in the whole case of constituting in an array.
In this embodiment, if the fulcrum member 4 is a polygonal pyramid, ten-sided seven-sided six-sided pyramids or a pyramid, or pyramids will also be available for it, for example. In the case of six-sided pyramids, it can change into three shaft orientations, and it can perform an optical deflection. Similarly, if it is an eight-sided pyramid and is ten-sided four axes and a pyramid, it can change into 5 shaft orientations and an optical deflection can be performed.
If it says, even if the fulcrum member 4 will be conical shape, for example, the electrode 6 of each other was insulated, if it divides into two or more electrodes of any number, anxiety is in the stability in the inclined position of the plate shape component 2 like eight pieces, but the same operation as the above can be carried out.
[0093]
Drawing 89 is a top view for explaining the principal part of the optical deflection equipment in which a 19th embodiment of this invention is shown.
Drawing 90 is an A-A' line sectional view of drawing 89.
At this embodiment, the plate shape component 2 comprises a component of a monolayer. For example, the function of the purpose can be attained, without combining a special reflective means by using construction material with reflectance high in itself like the aluminum.
[0094]
Drawing 91 is a figure for describing a 20th embodiment of this invention, drawing 91 (a) is a plan of optical deflection equipment, and drawing 91 (b) is a sectional view of the A-A' line. In order to avoid complicatedness, a sectional view shows only an amputation stump side. Also in all the sectional view, it is below the same. In the following explanation, a plate shape component and the component which was being called are only called a plate-like member until now. A bamboo hat shape member will be called a regulating member.
[0095]
In drawing 91, a substrate and the mark 2102 show a regulating member, the mark 2103 shows a fulcrum member, and, as for the mark 2100, the mark 2104 shows a plate-like member, respectively, as for optical deflection equipment and the mark 2101.
As for silicon or glass, although construction material of the substrate 2101 may be arbitrary, when a thing of a miniaturization is taken into consideration, what is generally used in a semiconductor process or a liquid crystal process is desirable. When it takes into consideration forming in the same substrate as the below-mentioned drive-system circuit in this invention (100), a silicon substrate which has a plane direction is desirable. Two or more regulating members 2102 are arranged in form with the stopper 2102a at an end. In order to make an area ratio of a reflection region when it array-izes into the maximum as construction material of the regulating member 2102, it can constitute from a thin film and space-saving as much as possible, and it is desired for a mechanical strength to be strong. In order to control a fall of mirror performance by the regulating member 2102, silicon oxide etc. which have translucency are desired, but when there is a possibility of becoming a cause of scattered reflection, optical absorption nature may be processed on the surface of the regulating member 2102.
[0096]
Although the fulcrum member 2103 is a cone, since it becomes a fulcrum in case the plate-like member 2104 is displaced, the form will not be asked if it is the form which can serve as a fulcrum. The crowning 2103a of the fulcrum member 2103 which touches the plate-like member 2104 at least is conductivity. As construction material of the fulcrum member 2103, if conductivity and a mechanical strength are taken into consideration, Lamination of an insulator layer and a metal membrane of

metal silicide films, such as low resistance crystalline silicon film and polycrystalline silicon film, a metal membrane or tungsten silicide, and titanium silicides, or silicon oxide, or a silicon nitride film is desirable. However, in order to give potential to the plate-like member 2104 in lamination of an insulator layer and a metal membrane, a connection hole which connects this metal membrane with a potential supply line is needed. The plate-like member 2104 does not have a fixed end. A movable range is restricted to predetermined space by the substrate 2101, the fulcrum member 2103, the regulating member 2102, and the stopper 2102a, and the plate-like member 2104 is formed by a manufacturing method mentioned later. The whole component of the plate-like member 2104 is a conductor layer. However, what is necessary is just to have a conductor layer which consists of the upper surface, a rear face, or the whole component, i.e., a conductive component at least in part, for the sake of convenience on which the below-mentioned electrostatic attraction is made to act.

[0097]

The contact portion 2104a by the side of the rear face of the plate-like member 2104 which touches the fulcrum member 2103 at least is conductivity. The above-mentioned conductor layer and one may be sufficient as the contact portion 2104a, and a different body may be sufficient as it. However, in the case of a different body, it is necessary to electrically connect both sides. As construction material of the plate-like member 2104, when conductivity and a mechanical strength are taken into consideration, it is desirable that they are metal membranes, such as aluminum, chromium, titanium metallurgy, and silver. When making the upper surface 2104b whole region of the plate-like member 2104 into a light reflex field, it is preferred that it is an aluminum system metal membrane with good reflection performance. The regulating member 2102 is arranged so that the plate-like member 2104 may have the movable range restricted as mentioned above and only the tilt displacement centering on the fulcrum member 2103 may happen mostly. It is desired for the plate-like member 2104 to be monotonous in the light reflex field 2104b at least. A reflecting direction is arranged and the light flux which entered into the light reflex field according to the plate-like member 2104 being monotonous can be reflected, and when using optical deflection equipment for an image forming device, an image projection display device, or an optical transmission device and it maintains the optical characteristic, it is important. Curvature-radius Ra is wanted to be not less than several meters as smoothness of the plate-like member 2104. When its attention is paid to the light reflex function of the light reflex field 2104b, it may only be called a light reflection surface.

[0098]

Drawing 92 is a figure showing a 21st embodiment of this invention. Drawing 92 (a) is a plan of optical deflection equipment, and drawing 92 (b) is a sectional view of an A-A' line.

In the figure, the marks 2100-2104 are the same as that of a 20th embodiment. The plate-like member 2104 is constituted by lamination of the conductor layer 2202 which consists of the dielectric layer 2201 which consists of a component which has a dielectric, and a component which has conductivity, And it is constituted by only the conductor layer 2202 in the contact portion 2104a of the plate-like member 2104 which touches the crowning 2103a of the fulcrum member 2103 at least. The same composition as the plate-like member 2104 in drawing 91 may be sufficient as the conductor layer 2202. As for the dielectric layer 2201, it is desirable for specific inductive capacity to have 3 or more and a high dielectric, and it is desirable for specific inductive capacity to indicate high dielectrics to be 6-8, and to be constituted with a silicon nitride film with a large mechanical strength. The mark 2203 shows the opening part formed in the dielectric layer 2201, and the contact portion 2104a enables it to contact the crowning 2103a. The opening part 2203 is formed by the patternizing by phototype process technology.

[0099]

Drawing 93 is a figure showing a 22nd embodiment of this invention. Drawing 93 (a) is a plan of optical deflection equipment, and drawing 93 (b) is a sectional view of a B-B' line.

In the figure, the marks 2100-2104 are the same as that of a 20th embodiment. The electrode 2301 for making electrostatic attraction act in a figure is formed on [four] the substrate 2101. The electrode 2301 is electrically separated from the conductive crowning constituted by the fulcrum member 2103. If it is desirable for it to be able to produce with the manufacturing method mentioned later like a 20th embodiment as construction material of the electrode 2301 and conductivity etc. are taken into consideration, Metal, such as aluminum system metal, titanium nitride, and titanium, is desirable, and at least a part of conductor layer constituted by the plate-like member 2104 has countered with the electrode 2301. The electrostatic attraction resulting from the potential difference of the potential given to either of the four electrodes 2301 formed in the substrate 2101 by that cause and the potential of the plate-like member 2104 given via the fulcrum member 2103 can be used among both, and the plate-like member 2104 can be displaced in the direction of the purpose (inclination). The displacement direction of the plate-like member 2104 is changeable at high speed by impressing arbitrary potential to other portions of the electrode 2301 which counters considering the fulcrum member 2103 as a center succeedingly. Direction of the inclination of the plate-like member 2104 is controllable by the biaxial direction with high precision by changing arbitrarily the potential given to each of the four electrodes 2301.

[0100]

Drawing 94 is a figure showing a 23rd embodiment of this invention. Drawing 94 (a) is a plan of optical deflection equipment, and drawing 94 (b) is a sectional view of a B-B' line.

Drawing 95 is a figure showing the modification of a fulcrum member.

In drawing 94, 2100-2102 are the same as that of a 20th embodiment. Basic constitution is the same although arrangement of the regulating member 2102 differs from a 20th embodiment. The fulcrum member 2401 is shown in drawing 94. Although the fulcrum member 2103 was a mere cone, a 22nd embodiment, The fulcrum member 2401 of this embodiment is ridge form in which the plate-like member 2104 is in contact with the fulcrum member 2401 by the line, and the fulcrum member 2401 has a slant face, therefore displacement of only 1 shaft orientations where the plate-like member 2104 is specified with said line of contact is obtained. As construction material of the fulcrum member 2401, it is the same as that of the construction material of the fulcrum member 2103 in the 1st embodiment.

[0101]

As shown in drawing 95 (a), the fulcrum member 2401 makes representation the square pillar of the reverse V shape form where a perpendicular section uses a point as a crowning, but as shown in drawing 95 (b), the form which has a radius of circle may be sufficient as the neighborhood of a crowning. Or as shown in drawing 95 (c), even if a section is a pentagon, it does not interfere. What is necessary is just the columnar body which, in short, had the plate-like member 2104 and ** which can carry out line contact. Since the fulcrum member 2401 which touches the plate-like member 2104 has touched by the line as shown in drawing 94 and drawing 95, the touch area of the fulcrum member 2401 and the plate-like member 2104 is reduced, it is stabilized and the tilt displacement of 1 shaft orientations by the electrostatic attraction of the plate-like member 2104 can be caused. Since the fulcrum member 2401 is the ridge form which has a slant face, the mechanical strength of the fulcrum member 2401 can be

strengthened. the contacted part 2402 with the end of a plate-like member [in / in displacement of the plate-like member 1204 / the substrate upper surface] -- or, Since it is regulated by either even if there are few stoppers 2102a of the regulating member 2102, the touch area of the plate-like member 2104 and other components is reduced as much as possible, and the substrate of the plate-like member 2104 and the adherence to others can be controlled.

[0102]

Drawing 96 is a figure showing a 24th embodiment of this invention. Drawing 96 (a) is a plan of optical deflection equipment, and drawing 96 (b) is a sectional view of a B-B' line.

In the figure, the marks 2100-2102, and 2104 are the same as that of a 20th embodiment, and the mark 2301 of them is the same as that of a 22nd embodiment. The mark 601 shows a fulcrum member, the mark 602 shows a conductive member, and the mark 603 shows an insulating film, respectively.

The slant face of the fulcrum member 601 of the optical deflection equipment 2100 has the four electrodes 2301 for [of the plate-like member 2104] being mostly formed corresponding to the whole region, and making electrostatic attraction act on a slant face. As construction material of the fulcrum member 601, since the electrode 2301 is constituted on the slant face of 601, it is desirable that it is insulation in order to separate inter-electrode electrically. In that case, in order to give potential to the plate-like member 2104, the crowning 601a of the fulcrum member 601 needs to form by the conductive member 602 which has conductivity. As for the conductive member 602, it is still more desirable to be simultaneously formed with the same film as the electrode 2301.

[0103]

In order to contact all over electrode 2301, to displace the plate-like member 2104, and to prevent the electric short circuit between the plate-like member 2104 and the electrode 2301, It is required to constitute the dielectric layer 2201 at the rear face of the plate-like member 2104, or to constitute the insulating film 603 on the electrode 2301, as shown in a 21st embodiment. As for the insulating film 603, it is desirable that they are silicon oxide which has insulation, or a silicon nitride film. In order that the insulating film 603 may not bar the potential grant to the plate-like member 2104, it is necessary to carry out the opening in the portion of the conductive member 602. In a figure, the plate-like member 2104 is approached, the electrode 2301 can be installed as the crowning 601a is approached, and thereby more big electrostatic attraction can be generated. In other words, displacement of the plate-like member 2104 is enabled more by the low voltage. Since field contact can be carried out in this embodiment on a slant face and the plate-like member 2104 can be displaced, the shock at the time of contact can be distributed. By carrying out field contact on a slant face, and displacing the plate-like member 2104, control of the displacement direction of a board becomes easy.

[0104]

Drawing 97 is a figure showing a 25th embodiment of this invention. Drawing 97 (a) is a plan of optical deflection equipment, and drawing 97 (b) is a sectional view of a B-B' line.

In drawing 97, the marks 2100-2102, and 2104 are the same as that of a 20th embodiment. The mark 2301 is the same as that of a 22nd embodiment. The marks 601 and 602 are the same as that of a 24th embodiment. The mark 604 shows a wrap insulation film for the electrode 2301 on a slant face selectively.

It is the same as that of the insulating film 603 shown in a 24th embodiment about construction material of the insulating film 604. In arbitrary parts on a slant face, the insulating film 604 on an electrode has many convex parts 701, and the direction of an optical deflection is prescribed by contact of the plate-like member 2104 to the convex part 701. As for the convex part 701, it is desirable to patternize an insulating film like the insulating film 603, and to be formed by the below-mentioned manufacturing method. A size, height, and an interval of the convex part 701 can be designed from electrostatic attraction and a rigid relation of a plate-like member as arbitrary form in the range which the plate-like member 2104 does not contact to the electrode 2301 of a concave part by elastic deformation. Since it is hard to carry out elastic deformation of the plate-like member when it is construction material whose plate-like member 2104 is hard enough, and a thick film, a size of the convex part 701 can be made as small as possible, height can also be made low, and an interval can be made large. A touch area with the plate-like member 2104 can be reduced as much as possible by that cause, and the possibility of adherence at the time of a drive over a long period of time can be reduced.

[0105]

Drawing 98 is a figure showing a 26th embodiment of this invention.

In this embodiment, the marks 2100 thru/or 2103 are the same as that of a 20th embodiment. The marks 2201-2203 are the same as that of a 21st embodiment. The marks 800a, 800b, 800c, and 800d show an electrode equivalent to the electrode 2301 shown in a 22nd embodiment. The marks 801 and 802 show a component of the fulcrum member 2103, the mark 801 shows an insulating layer and the mark 802 shows a conductive layer. The electrodes 800a, 800b, 800c, and 800d counter the plate-like member 2104 which consists of the dielectric layer 2201 and the conductor layer 2202, and are arranged, and construction material of them is the same as construction material of the electrode 2301 shown in a 22nd embodiment. The crowning 2103a of the fulcrum member 2103 is constituted by lamination with the insulating layer 801 which makes insulating silicon oxide construction material, and the conductive conductive layer 802. The conductive layer 802 is a component of the same construction material that was patternized simultaneously with the electrodes 800a, 800b, 800c, and 800d, and was formed.

[0106]

Drawing 98 (a) is a plan of the optical deflection equipment 2100 used for a 26th embodiment. Drawing 98 (b) is a sectional view of an A-A'line and B-B' line of the optical deflection equipment 2100 of an initial state. Drawing 98 (c-1) is a sectional view on an A-A'line top and C-C' line of the optical deflection equipment 2100 before a reset action. Drawing 98 (c-2) is a sectional view on an A-A'line top and C-C' line of the optical deflection equipment 2100 after a reset action. Drawing 98 (d) is a sectional view on an A-A'line top and C-C' line of the optical deflection equipment 2100 at the time of carrying out an optical deflection to one way. Drawing 98 (e) shows a sectional view on an A-A'line top and C-C' line of the optical deflection equipment 2100 at the time of changing and carrying out the optical deflection of the polarization axis.

[0107]

In drawing 98 (b), since the plate-like member 2104 does not have a fixed end, the position of the early optical deflection equipment 2100 is free in predetermined space. Then, in drawing 98 (b), the arrangement which keeps away from an electrode most was indicated. As shown in this figure, when the plate-like member 2104 is in the equal distance from all the electrodes on the substrate 2101, if the plate-like member 2104 is in a center valve position, it will be called irrespective of the existence of contact with the plate-like member 2104 and the crowning 2103a. The plate-like member 2104 has shown drawing 98 (c-1) contact before to the fulcrum member 2103. The plate-like member 2104 has shown drawing 98 (c-2) the contact back to the

fulcrum member 2103. From an initial state, in order to contact the plate-like member 2104 to the fulcrum member 2103, the reset action in drawing 98 (c-1) and drawing 98 (c-2) is performed.

[0108]

In a reset action, potential of the electrodes 800a and 800b is made into X(V)s, and potential of the electrodes 800c and 800d and the conductive layer 802 is made into 0(V). Since a plate-like member is in a state where it has floated electrically before the plate-like member 2104 contacts the fulcrum member 2103 of drawing 98 (c-1), electrostatic attraction distribution as shown by a downward white arrow in drawing 98 (c-1) is acquired. Henceforth, a size of a white arrow shows size of electrostatic attraction typically. Namely, electrostatic attraction acts via the plate-like member 2104 which has floated electrically between the electrodes 800a and 800b, the electrode 800c, and 800d, and the plate-like member 2104 can draw near at right angles to the substrate 2101 surface. Then, after the plate-like member 2104 contacts the fulcrum member 2103 of drawing 98 (c-2), Since potential of the plate-like member 2104 becomes equal to potential of the fulcrum member 2103, even if repulsive force acts between the plate-like member 2104 and the electrodes 800c and 800d, electrostatic attraction does not act, but strong electrostatic attraction acts between the plate-like member 2104 and the electrodes 800a and 800b. Therefore, the plate-like member 2104 inclines in a side with the electrodes 800a and 800b, the end 2104c of the plate-like member 2104 contacts the substrate 2101, a direction is regulated, and a reflected light is obtained in the specific direction. This state is made into a reset state and the direction of a reflected light at this time is called a reset direction.

[0109]

Potential X(V) impressed here is determined by distance, electric capacity, etc. of the plate-like member 2104 and an electrode, and is taken as a little larger voltage than voltage Z(V) of the limit which causes displacement of the usual plate-like member 2104, i.e., the inclination centering on the fulcrum member 2103. This voltage (potential difference like [Actually] the after-mentioned) is called the predetermined potential difference in this embodiment. Next, in drawing 98 (d), it is the potential of the electrodes 800a and 800b, 0(V) By changing electrodes [800c and 800d] potential to X(V)s, The plate-like member 2104 carries out tilt displacement to a reset direction and a counter direction at high speed, and the end 2104d of the plate-like member 2104 contacts the substrate 2101, has a direction regulated, and as shown in a figure, it will be in the state of "the optical deflection 1."

[0110]

Even if it adds the bias voltage of the value same irrespective of the polarity of positive/negative to each electrode and conductive layer, since the potential difference between each part is the same, operation does not change. That is, electrostatic attraction is generated in the potential difference which does not occur in the potential itself but exists between the components which counter. Although the potential of 0(V) is kept given to the conductive layer 802 of the fulcrum member 2103 and the potential by the side of an electrode is changed in this example, if displacement of the plate-like member 2104 is only changed to a reset direction and a counter direction, the same operation is obtained even if it adopts how to give potential in a reverse relation. That is, gave the potential of X(V)s to the electrodes 800a and 800b, the potential of 0(V) is kept given to the electrodes 800c and 800d, the potential of 0(V) is given to the conductive layer 802 at the time of reset, and it may be made to change to the potential of X(V)s at the time of the operation to the state of "the optical deflection 1." The plate-like member 2104 inclines in the direction in response to electrostatic attraction strong against the potential difference side that has potential difference between electrodes, or larger. That is, the displacement direction of the plate-like member 2104 is changeable at high speed by impressing arbitrary potential to the electrode which counters considering the fulcrum member 2103 as a center, and making potential of the conductive layer 802 equal to the potential of one of electrodes. These things can say the same thing also in future embodiments.

[0111]

Next, by making 0(V) and electrodes [800b and 800d] potential into X(V)s for the potential of the electrodes 800a and 800c and the fulcrum member 802 in drawing 98 (e), An axis is changed, the plate-like member 2104 carries out tilt displacement to the optical deflection of drawing 98 (d) at high speed, and the end 2104e of the plate-like member 2104 contacts the substrate 2101, has a direction regulated, and will be in the state of "the optical deflection 2." Also in these shaft orientations, by changing an electrode or the potential given to a conductive layer as mentioned above, an opposite direction can be made to be able to carry out the reversal inclination of the plate-like member 2104, and it can change into the state of "the optical deflection 3." Therefore, the plate-like member 2104 can take three positions in addition to an initial position. That is, direction of the inclination of the plate-like member 2104 is controllable by the biaxial direction with high precision. As mentioned above, by giving potential which is different in two or more electrodes, the plate-like member 2104 is displaced with electrostatic attraction, namely, it inclines focusing on a fulcrum, and the reflecting direction of the entering light flux can be changed in a total of four directions also including an initial position.

[0112]

Next, by giving potential which is different in the different electrodes 800a, 800b, 800c, and 800d and the conductive layer 802 in the plate-like member 2104 which has floated electrically like [at the time of the reset action of drawing 98 (c-1)] explains the principle which generates electrostatic attraction and is displaced briefly [drawing 99]. The explanation in drawing 99 indicates also including the effect which has arranged the conductor layer 2202 on the plate-like member 2104.

[0113]

Drawing 99 is a sectional view of the D-D' line at the time of a reset action of the optical deflection equipment 2100 in drawing 98.

In the figure, positive potential X(V) is impressed to the electrode 800b, and 0(V) is impressed to 800d of electrodes. Although electrostatic attraction occurs between the two electrodes 800b and 800d and the plate-like member 2104 which has floated electrically at this time and the plate-like member 2104 is displaced to the electrode side, in the electrode 800b, positive charge appears with the positive potential first impressed to the electrode 800b. And via the void 901, it is dielectrically generated by the negative charge in the dielectric layer 2201, and a negative charge spreads efficiently in electric conduction in the conductor layer 2202 simultaneously in it. Conversely, when it says, the dielectric layer 2201 is made to generate a negative charge efficiently by the conductor layer 2202.

[0114]

Since the dielectric layer 2201 and the conductor layer 2202 have floated electrically at this time, in the dielectric layer 2201 and the conductor layer 2202 which counter 800 d of electrodes via the void 901, positive charge spreads typically. In 800d of electrodes, it is typically generated by the negative charge so that it may correspond to the positive charge. Although 800 d of electrodes are 0(V) actually, it becomes such when it thinks typically. Electrostatic attraction occurs also in the plate-like

member located in 800d of electrode upper part by that cause. Although a series of flows explained the above-mentioned explanation, it does not necessarily happen by a series of flows, and electrodes [800b and 800d] potential difference generates those phenomena in synchronization. The dielectric layer 2201 and the conductor layer 2202 which have floated electrically actually serve as specific potential between the electrode 800b and 800 d of electrodes, and the electrostatic attraction by the potential of this specification and the potential difference of the electrode 800b, and the potential of this specification and the electrostatic attraction by the potential difference of 800 d of electrodes will occur. This specific potential becomes settled according to structural factors, such as the void 901 and electrodes [800b and 800d] area. Thus, the plate-like member 2104 carries out tilt displacement to the electrode side with the generated electrostatic attraction.

[0115]

Drawing 100 is a figure showing the 8th embodiment of this invention.

drawing 100 (a) -- drawing 98 (a) -- it is a plan of the similarly same optical deflection equipment 2100 as what was shown in a 26th embodiment. drawing 100 (b) -- drawing 98 (b) -- it is a sectional view of the A-A'line and B-B' line of the optical deflection equipment 2100 of an initial state similarly. Drawing 100 (c-1) and drawing 100 (c-2) are the sectional views on the A-A'line top and C-C' line of the optical deflection equipment 2100 of reset action before and the back, respectively like drawing 98 (c-1) and drawing 98 (c-2). Drawing 100 (d) is a sectional view on the A-A'line top and C-C' line of the optical deflection equipment 2100 at the time of carrying out an optical deflection to one way. Drawing 100 (e) is a sectional view on the A-A'line top and C-C' line of the optical deflection equipment 2100 at the time of changing and carrying out the optical deflection of the polarization axis.

[0116]

Although the reset action of the initial state of drawing 100 (b) and drawing 100 (c-1), and drawing 100 (c-2) resembles drawing 98, how to give potential is changed. Potential of abbreviated Y / 2 (V), and the electrode 800b is made [the potential of the electrode 800a] into 0(V) for Y(V), the electrodes 800c and 800d, and the potential of the conductive layer 802. By the phenomenon as the reset action explained by drawing 98 in which it is almost the same even when the plate-like member 2104 does not touch the fulcrum member 2103, the plate-like member 2104 contacts the fulcrum member 2103, and the potential of abbreviated Y / 2 (V) is given from the conductive layer 802.

Since the potential as a plate-like member with the same electrodes 800c and 800d is given, that between both does not commit electrostatic attraction. Both the potential difference between the electrode 800b, a plate-like member and the plate-like member 2104, and the electrode 800a serves as abbreviated Y / 2 (V), electrostatic attraction strong between an electrode and a plate-like member works, and the plate-like member 2104 inclines in a side with the electrodes 800a and 800b. This state is made into a reset state.

[0117]

In drawing 100 (d), the potential of the electrode 800c by making abbreviated Y / 2 (V), and potential of 800 d of electrodes into 0(V) for Y(V), the electrodes 800a and 800b, and the potential of the conductive layer 802, The plate-like member 2104 carries out tilt displacement to a reset direction and a counter direction at high speed, and the end 2104d of the plate-like member 2104 contacts the substrate 2101, has a direction regulated, and will be in the state of "the optical deflection 1." Even if it adds the bias potential of constant value to each electrode and conductive layer irrespective of the polarity of positive/negative, operation is completely the same. That is, the displacement direction of the plate-like member 2104 is changeable at high speed by impressing the arbitrary potential which differs in size to two adjoining electrodes, and giving the middle potential of the potential of said size to two remaining electrodes and conductive layers 802. Potential Y(V) impressed here is a specified value, and is defined on the following conditions. That is, it sets up become a little larger potential than voltage Z(V) of the limit that potential Y / 2(V) given to the conductive layer 802 cause displacement of the plate-like member 2104.

[0118]

In drawing 100 (e), the potential of the electrode 800b next, by making abbreviated Y / 2(V), and potential of 800 d into 0(V) for Y (V), the electrodes 800a and 800c, and the potential of the conductive layer 802, An axis is changed, the plate-like member 2104 carries out tilt displacement to the optical deflection of drawing 100 (d) at high speed, and the end 2104e of the plate-like member 2104 contacts the substrate 2101, has a direction regulated, and will be in the state of "the optical deflection 2." That is, direction of the inclination of a plate-like member is controllable by the biaxial direction with high precision. As mentioned above, by giving potential which is different in inter-electrode [two or more], the plate-like member 2104 inclines focusing on a fulcrum with electrostatic attraction, and the reflecting direction of the entering light flux can be changed. If drawing 100 (d) is described for an operation of the electrostatic attraction for an optical deflection briefly [an example] below, the potential of a plate-like member will also serve as abbreviated Y / 2(V) by making the fulcrum member 802 into abbreviated Y / 2(V). Therefore, since it is same electric potential in the part which counters the electrodes 800a and 800b, electrostatic attraction does not act mostly. Since potential difference arises in the part which counters the electrodes 800c and 800d to it in abbreviated Y / 2(V), it is respectively almost equivalent electrostatic attraction. Namely, the electrostatic attraction corresponding to the potential difference of abbreviated Y / 2(V) acts, and a plate-like member inclines in the direction of "the optical deflection 1." In drawing 100 (e), although axes differ, a plate-like member inclines in the direction of "the optical deflection 2" similarly. In this example, it is conditions that the electrode which gives maximum potential, and the electrode which gives minimum potential exist in the same side about the straight line which passes along the crowning of a fulcrum member used as the axis of displacement of a plate-like member. The adjoining electrode becomes conditions when the number of electrodes is four pieces.

[0119]

Next, drawing 100 (d) is explained to an example for the advantage of the optical deflection system of this embodiment. In drawing 100 (d), since Y(V) and 0(V) are impressed to the electrodes 800c and 800d, respectively, The plate-like member 2104 separates from the fulcrum member 2103 in process of tilt displacement temporarily, and even if the plate-like member 2104 will be in the state where it floated electrically, the plate-like member which counters the electrodes 800c and 800d like the description to drawing 99 can be made to generate electrostatic attraction. Thereby, the optical deflection to a target direction can be attained. That is, the optical deflection stable as an advantage can be made possible. With a figure, when [how / to use optical deflection equipment especially] the upper and lower sides are reverse, this effect shows up notably. That is, in such usage, it is because the plate-like member 2104 will always be separated from the fulcrum member 2103 when no potential is impressed to equipment.

Other advantages are acquired by combining with the 29th below-mentioned embodiment.

[0120]

Next, the modification embodiment of a 27th embodiment is described using drawing 100 (f). Abbreviated X / 2(V), and potential

of 800 d of electrodes are made [the potential of the electrode 800a] into 0(V) for the potential of X(V)s and the electrodes 800b and 800c, and potential of the conductive layer 802 is made into 0(V). Potential X(V) shown here is the same as what was explained by a 26th embodiment.
Since big potential difference is between the electrodes 800a, strong electrostatic attraction works, since small potential difference is among the electrodes 800b and 800c, weak electrostatic attraction works, and since there is no potential difference between 800 d of electrodes, electrostatic attraction does not commit the plate-like member 2104. Therefore, the plate-like member 2104 inclines in the direction of the electrode 800a like drawing 100 (f), and touches the substrate 2101 in 2104 f of corner points on the diagonal line of the plate-like member 2104. That is, although the displacement direction shown in drawing 100 (d) and drawing 100 (e) was an inclination to the direction of the neighborhood of the plate-like member 2104 which all show with a square mostly, the slope direction obtained by a modification embodiment is an inclination to the diagonal direction of the plate-like member 2104. Four kinds of slope directions are obtained depending on how to give the potential to an electrode also for this embodiment.
[0121]
Embodiment 27 and a transformation embodiment are the same composition, since they are only changing how to combine impression potential, are dependent on control and can change the reflecting direction of light in a total of eight directions. The same effect is acquired even if it performs control which combined the 26th embodiment and transformation embodiment. Since potential called abbreviated X / 2(V) given to the electrodes 800b and 800c generates weak electrostatic attraction between the plate-like members 2104 of potential 0(V), when the rigidity of the plate-like member 2104 is small, there is also a possibility that a deflection may occur. In such composition, potential given to the electrodes 800b and 800c may be made small, or it is good also as 0(V) of the conductive layer 802 and same electric potential, or it may be separated from a power supply and it may change it into the state where it floated electrically. When the potential given to the electrodes 800b and 800c is changed into the state where considered it as abbreviated X / 2(V), or it floated electrically, the slope direction of the plate-like member 2104 can be reversed to the electrode 800d side by the side of reverse only by switching the potential given to the conductive layer 802 to X(V)s from 0(V). It is foundations to give so that the potential difference between the electrode which exists in the direction, and the plate-like member 2104 may become the maximum to lean the normal of the light reflection surface of the plate-like member 2104 so that each example described above may show. It is as stated above that the number of electrodes at this time has one case and two cases. If the flat electrode 2104 inclines in the direction of neighboring and predetermined potential difference is given among one electrode between two electrodes which adjoin the flat electrode 2104 when giving predetermined potential difference simultaneously, it inclines toward a diagonal direction.
[0122]
Next, the form of the optical deflection equipment 2100 is described. By old explanation, in order to understand easily, the case where a plate-like member is a square mostly has been explained, but the composition of this invention is not limited to this. Even a maximum of four pieces have explained the number of the electrodes on a substrate, and this is not limited to four pieces, either.
Drawing 101 is a figure explaining a 28th embodiment of this invention. In Drawing 101, although an outside and others are constituted circularly, the marks 2100 thru/or 2104 are the same as that of the 1st embodiment. However, the fulcrum member 2103 is shown in the shape of [which has the bottom smaller than the diameter of a plate-like member] a cone. The marks 800a thru/or 800h are eight electrodes divided and provided in the side of the cone-like fulcrum member 2103, and each electrode is insulated mutually.
[0123]
Potential of X(V)s and the electrode 800e is made into 0(V) for the potential of the electrode 800a, and other electrodes are changed into the state where it floated electrically, for example. If the potential of 0(V) is given to the conductive layer 802 of the fulcrum member 2103, the plate-like member 2104 inclines in the direction of the electrode 800a according to the big potential difference between the electrodes 800a. If the potential of X(V)s is given to the conductive layer 802, the plate-like member 2104 inclines in the direction of the electrode 800e conversely. Thus, it becomes possible to make the plate-like member 2104 incline in all the directions with an electrode in the combination of the potential given to an electrode and a conductive layer. Therefore, eight directions can be selectively set up as a reflecting direction of light. Although the above-mentioned explanation explained the fulcrum member 2103 as a cone, it does not matter as for a right 8 pyramid object. When it constitutes from a view similar to a 23rd embodiment so that the plate-like member 2104 may be made to meet the slant face of a fulcrum member at the time of operation, as for setting out of a slope direction, the side of a pyramid object is stabilized from the side of a cone. Although eight electrodes explained in this example, the number is completely free in the range which can make a pyramid object. That is, if it installs so that it may have a slant face mostly corresponding to the whole region, and only the number of slant faces provides the electrode of a plate-like member insulated mutually in each slant face for the pyramid object shown above instead of the columnar body used for a 23rd embodiment, the stable optical deflection equipment which has arbitrary numbers of deflection directions will be obtained.
[0124]
It said that they are conditions that how to give the potential in a 27th embodiment exists in the same side about the straight line which passes along the crowning of the fulcrum member from which the electrode which gives maximum potential, and the electrode which gives minimum potential serve as an axis of displacement of a plate-like member. When the number of electrodes is six or more pieces, it becomes unnecessary it to be indispensable that it is an adjoining electrode, when the number of electrodes is four pieces, but to necessarily adjoin. That is, other one or more electrodes may be contained between the electrode which gives maximum potential, and the electrode which gives minimum potential. When the number of electrodes is six pieces, only one piece cannot enter in between, but when the number of electrodes is eight pieces, a maximum of two pieces can enter in between. Thus, if potential is given, displacement of a plate-like member inclines according to a power relationship towards the middle of the two electrodes which gave potential difference. If the number of electrodes caught in between is odd number, i.e., one piece, or three pieces, a plate-like member is contacted and stabilized on the slant face of a middle electrode. Therefore, if it changes into the state where it floated electrically without giving potential to the electrode caught between this, the greatest potential difference is not built over the electrode of contiguity, and discharge and the operation which does not have fear of a short circuit and was stabilized can be expected.
[0125]
Drawing 102 is a figure explaining a 29th embodiment of this invention. According to this embodiment, on arbitrary substrates, the optical deflection equipment 2100 was arranged in array form, and was made into the optical deflection array 1200. Drawing 102

(a) is a plan and 102 (b) is a sectional view of an A-A' line. Although the state where it arranged to one dimension is shown by a diagram, you may arrange to two dimensions. By integrating the optical deflection equipment 2100, drive controlling of the optical deflection equipment 2100 can be carried out that it is simultaneous and independently, and an optical deflection can be carried out. The individual optical deflection equipment 2100 when it is integrated in this way and arranges to array form may be called an "element" for convenience.

[0126]

Next, a 30th embodiment is described. Atmosphere near the plate-like member 2104 of the optical deflection equipment [in / in optical deflection equipment in this embodiment / the 20th thru/or a 29th embodiment] 2100 is a vacuum mostly. As a method of forming a vacua, when package-izing the optical deflection equipment 2100, it can attain by carrying out a vacuum lock. A case of Embodiment 30 which formed into the one-dimensional array two or more optical deflection equipment 2100 which shows an advantage mostly made into a vacua in Drawing 102 at drawing 98 is explained as an example. As mentioned above, in each element of the optical deflection array 1200 of Drawing 102, 2101 and 2102 are the same as that of drawing 91. 2201-2203 are the same as that of drawing 92. 800a, 800b, 800c, 800d, and 801 and 802 are the same as that of drawing 98. Drawing 102 (a) is a plan of the optical deflection array 1200 of Embodiment 30. Drawing 102 (b) is a sectional view of an A-A' line of the optical deflection array 1200 in a case of performing optical deflections with each arbitrary element.

[0127]

Drawing 102 (b) shows typically a case where atmosphere near the plate-like member 2104 is the usual atmosphere. When the plate-like member 2104 of one element (left end element) carried out tilt displacement, the atmosphere of plate-like-member 2104 directly under will be pressured, and will do lift to an adjoining element (central element). An adjoining element has displacement to the direction of the purpose shown by a white arrow barred by this. By making atmosphere near the plate-like member 2104 into a vacuum mostly, influence of the above-mentioned lift can be inhibited in the optical deflection array 1200. In optical polarization equipment of a simple substance, when it package-izes so that dust in the air, etc. may not enter, and the circumference of equipment may be covered with covering, a gas of atmosphere serves as viscous resistance to change of a rapid inclination of the plate-like member 2104 by voltage impressing, and it can prevent few response delays arising.

[0128]

Next, a 31st embodiment is described. The optical deflection equipment 2100 of this embodiment is a gas [inertness / atmosphere / near the plate-like member 2104]. As an inertness gas, there are nitrogen, argon, helium, neon, etc. and comparatively inexpensive and safe nitrogen is desirable in it. As a method of forming an inertness gaseous atmosphere, when package-izing the optical deflection equipment 2100, it can attain by closing in inert gas. atmosphere near the plate-like member -- this -- an advantage made into an inertness gas is being able to control adherence in a point of contact when moisture in atmosphere can be reduced, a plate-like member's carries out tilt displacement by that cause and it contacts to a substrate, and a point of contact of a fulcrum member and a plate-like member. However, if there is a possibility that an enclosure gas may serve as viscous resistance to displacement of the plate-like member 2104, it is desirable to use low pressure if possible and to enclose.

[0129]

The embodiment which applied this invention to the image projection display device is described using Drawing 103. Drawing 103 is a figure explaining the example which applied the optical deflection array 1200 of this invention to the image projection display device. In the figure, an image projection display device and the mark 1301 the mark 1300 An optical switch means, The mark 1302 extracts a light source, a lens and the mark 1304 extract the mark 1303, the mark 1305 shows a rotary collar hole, the mark 1306 shows a microlens array, and the mark 1310 shows a projection screen, respectively.

Either the optical deflection equipment 2100 or the optical deflection array 1200 can be used as an optical switch means of the display (namely, light-and-darkness display of pixel) equipment of image projection data. Therefore, light-and-darkness control (namely, ON/OFF control of an optical switch) of a pixel is good, and can control the stray light (reflected light from the adjacent elements generated when a reflecting direction is in disorder), and high-speed operation can be possible, long-term reliability can be high, and it can drive by the low voltage, and a contrast ratio can be improved. The optical deflection array 1200 is used in this embodiment.

[0130]

The optical switch means 1301 which consists of the optical deflection array 1200 which changes the reflecting direction of the incoming beam (R) of projection picture data, performs an optical deflection, and projects a picture projects a picture on the projection screen 1310, and displays the image projection display device 1300 which projects and displays a picture. The incoming beam (R) from the light source 1302 is irradiated with the above-mentioned optical switch means 1301 by the optical deflection array 1200, It reflects according to the light reflection surface of the plate-like member 2104 of each element in the optical deflection array 1200, and projects on the above-mentioned projection screen 1310 via the projection lens 1303 and the diaphragm 1304. In order to perform a colored presentation, the rotary collar hole 1305 may be formed in front of the above-mentioned light source 1302. The microlens array 1306 can also be used for improved efficiency. Therefore, the structure of changing the reflecting direction of incident light and performing an optical deflection is easy, and a response is also quick, Without restricting the wavelength of the incident light (R) to be used, an operation can be stable, it can be low reliable, and driver voltage could provide the image projection display device 1300 in which a manufacturing process possesses the optical deflection array 1200 of low cost few.

[0131]

Next, the method of desirable arrangement of the optical deflection array 1200 in an image projection display device is explained. That is, it arranges so that the normal line direction of the light reflection surface in the center valve position of the plate-like member 2104 of each element of the optical deflection array 1200 may become in the direction mostly with the operation direction of gravity. Since gravity acts on the plate-like member 2104 when the plate-like member 2104 contacts the fulcrum member formed in the substrate face 2101 by arranging in this way when the optical deflection array 1200 of this invention was used for an image projection display device, Gravity acts uniformly and the inclination of the plate-like member 2104 to the direction of which electrode does not have a bias, either. Thereby, when the plate-like member 2104 carries out tilt displacement, the further stable operation, i.e., the existing operation of long term reliability or repeated reproducibility, can be obtained. Since the plate-like member equivalent to a deflection mirror does not have a fixed end, the optical deflection equipment 2100 of this invention is more effective. Since Drawing 103 is a figure explaining general usage, the direction specific about direction of the center valve position of the plate-like member 2104 of each element of the optical deflection array 1200 is not shown, but when adopting this arrangement, if a reflector etc. are used in the middle, the purpose can be attained if needed. Even when using

optical deflection equipment instead of an optical deflection array, the above-mentioned arrangement is effective similarly.
[0132]
The embodiment which applied this invention to the image forming device is described using Drawing 104.
Drawing 104 is a figure showing the example which applied the optical deflection array 1200 of this invention to image forming devices, such as a copying machine. in a figure — image forming device 1400 As main functional blocks, It consists of the picture support 1401 of the photo conductor of drum shape, the latent image formation means 1402, the developing means 1403, the transfer means 1404, the electrifying means 1405, the fixing means 1406, the delivery tray 1407, and the cleaning means 1408. Since this example includes the optical deflection array 1200 in the latent image formation means 1402, its ON/OFF control at the time of optical writing is good, The stray light (reflected light from the adjacent elements generated when a reflecting direction is in disorder) can be controlled, and high-speed operation can be possible, long-term reliability can be high, and it can drive by the low voltage, and a S/N ratio can be improved.
[0133]
Since it is a well-known image forming means except latent image formation means 1402, the detailed explanation about them is omitted. The picture support 1401 is held pivotable in the direction of arrow D of a graphic display, and supports a formed image. The latent image formation means 1402 uses the optical deflection array 1200 of this invention as a line exposure type exposure means.
On the photo conductor uniformly electrified in the electrifying means 1405, optical writing is performed by the latent image formation means 1402, and a latent image is formed. Namely, corresponding to the inputted image data, switching of each element of the optical deflection array 1200 is performed, It develops by the developing means 1403, as for the formed latent image, a toner image is formed, the formed toner image is transferred by the transferred object (P) by the transfer means 1404, and after being established by the fixing means 1406, a transferred object (P) is delivered to the delivery tray 1407, and is stored. On the other hand, the photo conductor of the drum shape of the described image support 1401 after transferring a toner image to a transferred object (P) by the above-mentioned transfer means 1404 is cleaned by the cleaning means 1408, and prepares for the image formation of a next step.
[0134]
The above-mentioned latent image formation means 1402 the incoming beam (R) from the light source 1402a, The element arranged via the 1st lens system 1402b at array form is irradiated, [two or more] Each element makes the surface on the photo conductor of the drum shape of the picture support 1401 carry out image formation of the incoming beam (R) through the 2nd lens system 1402c through the optical deflection array 1200 as a reflective means according to picture information. Therefore, the structure of an optical deflection of changing the reflecting direction of incident light is easy, and a response is also quick, Without restricting the wavelength of the incident light to be used, driver voltage is low, and an operation can be stable, it can be reliable, and the image forming device 1400 with which a manufacturing process possesses the optical deflection array 1200 of low cost few could be provided.
[0135]
An embodiment which applied this invention to an optical transmission device is described using Drawing 105.
Drawing 105 is a figure showing an example which applied the optical deflection array 1200 of this invention arranged in two dimensions to an optical transmission device.
It is a figure in which Drawing 105 (a) shows an example of optical electrical transmission from two or more ports in two or more ports, and Drawing 105 (b) shows an example of optical electrical transmission from a port in two or more singular ports.
The optical transmission device 1500 is provided with the following in Drawing 105 (a).
As basic constitution, it is the lightwave signal input part 1502.
The 1st step of optical deflection array 1503.
The control device 1504.
The 2nd step of the optical deflection array 1505, its control device 1506, the lightwave signal outputting part 1507, and the signal transduction port 1508.

From using as an optical switch means to change the reflecting direction of an input light information signal for the optical deflection array 1200, and to determine the port of an outputted ray information signal in Drawing 105 (a). The optical deflection of the biaxial direction can be performed correctly easily, by that cause, control of selection of a port is good and can control the stray light to an adjacent port, and a high-speed optical-path change is possible, long-term reliability is high, and it can drive by the low voltage, and can be integrated on the same substrate.
[0136]
A light information signal is inputted into the optical transmission device 1501 of this invention from the lightwave signal input part 1502 which has two or more signal transduction ports 1508, It is deflected by two steps of optical deflection arrays 1503 and 1505 in the biaxial direction, and is outputted from the lightwave signal outputting part 1507 which chooses an output port and has two or more signal transduction ports 1508. In this example, in order to take a large optical deflection angle, it was considered as two steps, the 1st step of optical deflection array 1503, and the 2nd step of optical deflection array 1505, but depending on the number of connections to choose, the number of optical deflection arrays may be one. The optical deflection arrays 1503 and 1505 possess the control devices 1504 and 1506 for carrying out drive controlling of each element in each optical deflection array being simultaneous and independently, respectively. By old explanation, in order to make it intelligible, have explained the signal input part, the signal output part, or an input port and an output port as what [different], but. Since bidirectional transmission is possible for optical transmission, it does not usually need to distinguish a signal input part, a signal output part, or an input port and an output port in practice as a "signal input output section" or "input/output port."
[0137]
Other embodiments of an optical transmission device are described using Drawing 105 (b). The composition of this embodiment has the one input/output port 1511, and has the signal input output section 1513 only with the input/output port 1514 of only the number of the directions of the selectable reflected light of the optical deflection equipment 2100 of a simple substance, and the optical deflection equipment 2100. although the figure shows the case where the optical deflection equipment 2100 shown in Embodiment 26 is used — the direction of a reflected light selectable in this embodiment — method ** of four — it is a certain **, and even if it is one piece as one input/output port, as input/output port of another side, it can set up to four pieces. The solid line which shows the optical path of a figure shows the case where the one input/output port 1514 is chosen by the optical deflection equipment 2100, and a dashed line shows the case where it is switched to other input/output port. Although the

input/output port 1511 and the optical deflection equipment 2100 are optically connected via the reflector 1512 in the figure, a reflector can be stopped, the input/output port 1511 can also be arranged to the central part of the signal input output section 1513, and it becomes structural very easy. Two or more sets can unify and the set of the input/output port of such a combination can also be used.

[0138]

Next, the manufacturing method of optical deflection equipment is explained.

Drawing 106 is a figure showing the manufacturing process of the optical deflection equipment 2100 or an optical deflection array.

Drawing 106 (a) The optical deflection equipment 2100 shown in a 26th embodiment was taken for the example, and it was shown in - (h) in accordance with the typical process. Drawing 106 (a) - (h) is a section schematic view on the B-B' line in the embodiment.

Two or more divisions are formed on a silicon substrate. One dimension or two dimensions may be sufficient as arrangement of a division. If it is the purpose of obtaining the optical deflection equipment of a simple substance, the margin for separation will be provided between each division. If it is the purpose of obtaining an optical deflection array, each division will be stuck and will be formed.

[0139]

Drawing 106 (a): The silicon oxide 1601 which constitutes the dielectric layer 801 of a fulcrum member accumulates with plasma CVD method on the silicon substrate 2101,

With then, the photo-engraving process using the photo mask in which the pattern which has area gradation was formed and the photo-engraving process which carries out resist pattern formation post heating modification. The resist pattern which has the form and the thickness with the almost arbitrary shape of isomorphism of a fulcrum member is formed, and the purpose-shaped dielectric layer 801 is formed by the technique of the dry etching method after that.

Drawing 106 (b): Form the conductive layer 802 of the electrodes 800b and 800d and a fulcrum member with the thin film of a titanium nitride (TiN) film. The electrodes 800a and 800c which are not visible to a figure are also simultaneously formed at this time.

The TiN film formed membranes by the DC magnetron sputtering method which targeted Ti, and was patternized as two or more electrodes with the technique of the photo-engraving process and the dry etching method.

[0140]

Drawing 106 (c): The amorphous silicone film was made to deposit by a sputtering method, and flattening was carried out by processing time control using CMP technology.

The amorphous silicon film which remains is the 1st sacrifice layer 1602. As a sacrifice layer, a polyimide film, a photosensitive organic layer (resist film generally used in a semiconductor process), a polycrystalline silicon film, etc. can also be used besides the above-mentioned film, As the technique of flattening, the reflow method by heat treatment and the etchback method by dry etching can also be used.

Drawing 106 (d): The silicon nitride film was made to deposit with plasma CVD method as the dielectric layer 2201 of a plate-like member, it patternized with the technique of the photo-engraving process and the dry etching method, and the opening 2203 and the dielectric layer 2201 were formed. The aluminum system metal membrane used as the conductor layer 2202 which serves as a light reflex field succeedingly was made to deposit by sputtering technology, and it patternized by the photo-engraving process and the dry etching method.

[0141]

Drawing 106 (e): The amorphous silicone film was made to deposit by a sputtering method, and it was considered as the 2nd sacrifice layer 1603. As a sacrifice layer, a polyimide film, a photosensitive organic layer (resist film generally used in a semiconductor process), a polycrystalline silicon film, etc. can also be used after all besides the above-mentioned silicone film. The 2nd sacrifice layer 1603 is wanted to be the same construction material as the 1st sacrifice layer 1602.

Drawing 106 (f): In order to separate the optical deflection equipment 2100 individually and to arrange the regulating member 2102 around a plate-like member, the 1st sacrifice layer 1602 and 2nd sacrifice layer 1603 were simultaneously patternized by the photo-engraving process and the dry etching method a little more widely than a plate-like member.

Drawing 106 (g): The silicon oxide which constitutes the regulating member 2102 was made to deposit with plasma CVD method, and it patternized in arbitrary parts by the photo-engraving process and the dry etching method, and was considered as the regulating member 2102.

Drawing 106 (h) : the 1st sacrifice layer 1602 and 2nd sacrifice layer 1603 that remain by wet etching technology with tetramethylammonium hydroxide (TMAH) liquid. Etching removal is carried out through an about 2102-regulating member opening, the plate-like member 2104 is arranged to the space where the movable range was restricted, and the optical deflection equipment of this invention is completed.

[0142]

Next, the manufacturing method of the optical deflection equipment in the 25th embodiment is explained. This manufacturing method is some processes of the manufacturing method of the optical deflection equipment 2100, has at least a process which makes a dielectric thin film deposit on two or more electrodes, and has the process of patternizing that thin film and forming a convex part.

Drawing 107 is a figure showing the process of forming the convex part of the slant face of the fulcrum member of the optical deflection equipment 2100.

Typical ****** was shown in Drawing 107 (a) - (i). Drawing 107 (a) - (i) are the section schematic views on a B-B' line.

[0143]

Drawing 107 (a) : The silicon oxide which constitutes a fulcrum member accumulates with plasma CVD method on the silicon substrate 2101, With then, the photo-engraving process using the photo mask in which the pattern which has area gradation was formed and the photo-engraving process which carries out resist pattern formation post heating modification. The resist pattern which has the form and the thickness with the almost arbitrary shape of isomorphism of a fulcrum member is formed, and the purpose-shaped fulcrum member 601 is formed by the technique of the dry etching method after that.

Drawing 107 (b): Form the component 602 which has the conductivity of the electrode 2301 and a fulcrum member with the thin film of a titanium nitride (TiN) film.

The TiN film formed membranes by the DC magnetron sputtering method which targeted Ti, and was patternized as two or more electrodes with the technique of the photo-engraving process and the dry etching method.

[0144]
Drawing 107 (c): Silicon oxide accumulates with plasma CVD method as the insulator layer 603 for preventing the electric short circuit of a plate-like member and an electrode, and the purpose-shaped convex part 701 is patternized by arbitrary parts with the technique of a photo-engraving process and the dry etching method after that. In order to give the potential of a plate-like member simultaneously at this time, the opening of the neighborhood of a crowning of a fulcrum member is carried out.
Drawing 107 (d): The amorphous silicone film was made to deposit by a sputtering method, and flattening was carried out by processing time control using CMP technology.
The amorphous silicon film which remains is the 1st sacrifice layer 1702. As a sacrifice layer, a polyimide film, a photosensitive organic layer (resist film generally used in a semiconductor process), a polycrystalline silicon film, etc. can also be used besides the above-mentioned film, As the technique of flattening, the reflow method by heat treatment and the etchback method by dry etching can also be used.
[0145]
Drawing 107 (e): The aluminum system metal membrane which has conductivity as the plate-like member 2104 to serve also as a light reflex field was made to deposit by sputtering technology, and it patternized by the photo-engraving process and the dry etching method.
Drawing 107 (f): The amorphous silicone film was made to deposit by a sputtering method, and it was considered as the 2nd sacrifice layer 1703. As a sacrifice layer, a polyimide film, a photosensitive organic layer (resist film generally used in a semiconductor process), a polycrystalline silicon film, etc. can also be used after all besides the above-mentioned silicone film. The 2nd sacrifice layer 1703 is wanted to be the same construction material as the 1st sacrifice layer 1702.
[0146]
Drawing 107 (g): In order to separate the optical deflection equipment 2100 individually and to arrange the regulating member 2102 around a plate-like member, the 1st sacrifice layer 1702 and 2nd sacrifice layer 1703 were simultaneously patternized by the photo-engraving process and the dry etching method a little more widely than the plate-like member 2104.
Drawing 107 (h): The silicon oxide which constitutes the regulating member 2102 was made to deposit with plasma CVD method, and it patternized in arbitrary parts by the photo-engraving process and the dry etching method, and was considered as the regulating member 2102.
Figure 107(i) : the 1st sacrifice layer 1702 and 2nd sacrifice layer 1703 that remain by wet etching technology with tetramethylammonium hydroxide (TMAH) liquid. Etching removal is carried out through an about 2102-regulating member opening, a plate-like member is arranged to the space where the movable range was restricted, and the optical deflection equipment of this invention is completed.
[0147]
Here, form of the fulcrum member 2103 is explained using Drawing 108 and Drawing 109.
Drawing 108 (a) is a figure showing a basic cone. In this figure, the crowning 2103a of the cone 2103 serves as a sharp tip. Since there is also a possibility that it may become impossible to be unable to maintain this tip form in supporting this in order that stress may concentrate on a point of contact of both components when electrostatic attraction acts on the plate-like member 2104, as shown in Drawing 108 (b), since a small operation stable when formed spherically is acquired in the crowning 2103a, it is good. Drawing 108 (a) and (b) — in [both of] form, as shown in Drawing 108 (c), it is still better to make it form which made a pillar which has the bottom of the same type as a path of this bottom under the cone bottom unite. That is, since a vertical angle of a cone can be enlarged when making height of a fulcrum member the same, top intensity stability is obtained. Even if it uses such form, similarly a use top can completely be treated.
[0148]
Instead of making a crowning spherical, you may make it a flat surface. If truncated cone shape is used as shown in Drawing 109 (a), and tip form is lost, worries about stress concentration will disappear further and danger, such as breakage of a fulcrum member, will decrease more. Form as shown in Drawing 108 (c) and Drawing 109 (b) which made a pillar which has the bottom of the same type as a path of this bottom under the bottom of a truncated cone unite similarly may be sufficient. An effect is the same as a case of Drawing 108 (c) almost. If area of the crowning 2103a does not become not much large, as shown in Drawing 109 (c), it can use once also with a mere pillar. Manufacture is easy although this form does not have a portion of a cone.
[0149]
The modification embodiment to the convex part in a 25th embodiment of this invention shown in Drawings 110 and 111 by drawing 97 is shown.
In Drawing 110, the mark 2005 shows a convex part. Although the convex part 2005 is obtained by the same manufacturing method as the convex part 701 of the embodiment shown in drawing 97 and the same role is played, the form differs in the convex part 701.
The convex part 2005 is arranged by band-like [two or more] on the four electrodes 2301 with the insulating film. The width of a belt, an interval, length, etc. can be designed from electrostatic attraction and the rigid relation of a plate-like member as arbitrary form in the range which the plate-like member 2104 does not contact to the electrode 2301 of a concave part by elastic deformation as they were mentioned above. The slant face of the polygonal-pyramid object described in the embodiment of not only the fulcrum member of the columnar body which has a crowning of the shape of a ridge shown in drawing 97 but Drawing 101 may be sufficient as the slant face which forms a convex part.
It faces creating the photo mask for forming a convex part, and since the size of these convex part is close to a resolution limit, with the composition of the circular chisel shown in drawing 97, accuracy falls easily. Then, accuracy is made easy to enlarge in area and to send by constituting in band-like, like this example.
[0150]
In Drawing 111, the mark 2105 shows a convex part. It is related and the convex part 701 of the embodiment shown in drawing 97 of it is the same as the above-mentioned convex part 2005, although the convex part 2105 is formed by a different manufacturing method in part.
The convex part 2105 does not appear on the electrode 2301, and has composition which has been projected between electrodes.
[0151]
Before the convex part 2105 forms four electrodes, it is formed with the predetermined pattern at the time of formation of the fulcrum member 601. Although what is necessary is just to patternize the surface of fulcrum member 601 self when the fulcrum member 601 is formed by the insulating material, when the fulcrum member 601 is a conductive member, after giving an insulating

film to the surface after fulcrum member 601 formation, the band-like insulating convex part 2105 is formed with a predetermined pattern. The electrode 2301 is formed only in the flat part around the convex part 2105. However, although it is necessary to form the conductive member 602 for supplying potential to the plate-like member 2104 in the crowning of the fulcrum member 601 apart from this, a process top can be formed together, when forming the above-mentioned electrode 2301. It is because there is a possibility that it may be generated on the convex part surface by the electrostatic charge by polarization, and this may adsorb the plate-like member 2104 when the Reason for forming the electrode 2301 only in places other than a convex part has an electrode under a convex part. When this adsorption becomes strong, even after the impressed electromotive force to an electrode disappears, while the plate-like member 2104 had stuck to the convex part, it may separate and twist, and what is called an adherence phenomenon may occur.

[0152]

Drawing 112 is a figure showing the embodiment of a regulating member in the case of arranging in the maximum dense state the circular optical deflection equipment 2100 of the 9th embodiment shown in Drawing 101, and constituting it in two-dimensional array form. In order that a figure may illustrate easily, the minimum composition is shown, but that by which a majority of such composition was arranged practically length and horizontally is used.

In a figure, mark 2102' shows the compound regulating member shared by two pieces of optical deflection equipment. general — a circle — the maximum -- when it arranges densely, six circles are located in a line with the circumference of one circle that there is no crevice in regular intervals. Therefore, the regulating member 2102 can coincide the position of the substrate 2101 which adjoins if it forms on the circumference of the substrate 2101 at six regular intervals, and a regulating member. When it is integrated and makes two or more optical deflection equipment 2100 at once, if the position of a regulating member is in agreement, both can be unified and it can form as compound regulating member 2102'. Although a graphic display in particular is not carried out, it is the same that the regulating member of the substrates which adjoin also in the case of a one-dimensional array can be unified. However, four pieces shown in Drawing 101 may be sufficient as the number of the regulating member in one-dimensional. Since substrates are connected length and horizontally when arranging in the shape of a square matrix even if it is a two-dimensional array, as shown in Drawing 101, four pieces of a regulating member are good exactly.

[0153]

Drawing 113 is a perspective view for describing the modification embodiment of the regulating member 2102. Drawing 114 is a sectional view of the optical deflection equipment 2100 which used the regulating member 2102 of the above-mentioned modification embodiment.

The regulating member 2102 shown in Drawing 113 (a) has the extended base 2102b projected to the opposite direction in the lower end part of the straight part 2102c with the projection direction of the stopper 2102a established in the crowning of the straight part 2102c. This regulating member 2102 is used when providing a regulating member in the peripheral edge part of the substrate 2101 as shown in drawing 91 or Drawing 101. As shown also in Drawing 114, the space regulated as a movable range of the plate-like member 2104 is limited to the range in which only a part with the extended base 2102b of the regulating member 2102 is smaller than the substrate 2101. If the Reason carried out in this way has a not much small area of the portion which the regulating member 2102 joins to the substrate 2101, it will be because there is a possibility of becoming easy to damage also to slight stress, and sufficient intensity will come to be obtained by enlarging the above-mentioned plane-of-composition product by the extended base 2102b.

[0154]

The regulating member 2102 shown in Drawing 113 (b) enlarges the above-mentioned plane-of-composition product about the regulating member in a corner as shown in drawing 94. Since directions and an effect are the same as the above, explanation is omitted.

[0155]

Drawing 115 is a perspective view showing the further modification embodiment of a regulating member.

Drawings 116 and 117 are sectional views showing the example of use of the regulating member of a modification embodiment.

In a figure, mark 2102' shows the compound regulating member shared by two pieces of optical deflection equipment like Drawing 112. When putting two or more optical deflection equipment in order, making it array form and using, a regulating member can be shared in the connecting position of adjoining optical deflection equipment. The example is shown in Drawing 102 or Drawing 112. a figure -- 115 — (— a --) — being shown -- composite -- a regulating member -- 2102 — ' — a figure -- 113 — having been shown -- a regulating member — 2102 — modification — it is — two -- a piece -- a regulating member -- extension — a base -- comrades -- associating — making — having connected — a form — a base — 2102 — ' — b — having — **** . To conversely, the both ends whose plate-like base 2102'b which lies ranging over division into equal parts in both substrates will counter on the boundary line K of the two adjoining substrates 2101 if it says. Straight part 2102'c is provided and it has said boundary line K and the form where the stopper 2102a which projects to an opposite direction was formed, respectively at the crowning of both straight part 2102'c.

[0156]

In the same position as the above, compound regulating member 2102' shown in Drawing 115 (b) has a form which stuck mutually the near field where two pieces and a stopper do not exist the regulating member 2102 shown in drawing 91, and connected it, and resembles the form of the character of T of the alphabet. Straight part 2102'c shown in Drawing 115 (a) is made into the thickness doubled two sheets or the thickness beyond it, in this composition, since area of the portion joined to the substrate 2101 is enlarged, it does not have the form in particular as a base, but it will have sufficient intensity.

[0157]

Drawing 118 thru/or Drawing 127 are figures showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.

In a figure, the marks 2802, 2803, and 2804 show the 1st, 2nd, and 3rd sacrifice layer, respectively.

The fulcrum member 2103 is formed on the substrate 2101 (Drawing 118).

On the silicon substrate 2101 which has a plane direction [100], the silicon oxide film which constitutes the fulcrum member 2103 accumulates with plasma CVD method. With then, the photo-engraving process using the photo mask which has area gradation in which the pattern was formed and the photo-engraving process which carries out resist pattern formation post heating modification. The resist pattern which has the arbitrary thickness of the almost same form as the fulcrum member 2103 was formed, and the purpose-shaped fulcrum member 2103 was formed by the technique of the dry etching method after that.

An about 2-micrometer silicon oxide film may be formed on the silicon substrate 2101 which has the above-mentioned [100] plane direction, and processing same in about 1 micrometer of the upper layer may be performed.

The height of the crowning 2103a of the fulcrum member 2103 is about 1 micrometer.
[0158]
Subsequently, two or more electrodes 2301 are formed (Drawing 119).
The electrode 2301 is formed with the thin film of titanium nitride (TiN). The TiN film formed membranes in thickness of 0.01 micrometer by the DC magnetron sputtering method which targeted Ti, and was patternized as the plurality 2301, for example, four electrodes, with the photo-engraving process and the technique of the dry etching method.
Next, the protective film 2301a is formed on the electrode 2301 (Drawing 120).
As the protective film 2301a, the silicon nitride film was formed by 0.2 micrometer of thickness with plasma CVD method.
[0159]
Next, the 1st sacrifice layer 2802 is formed (Drawing 121).
As the 1st sacrifice layer 2802, 2 micrometers of amorphous silicon films are made to deposit by a sputtering method, using CMP technology, the crowning 2103a of the fulcrum member 2103 makes it expose, time is made to exceed further, and flattening is carried out by processing time control. By considering it as the fulcrum member 2103 and polishing selectivity high CMP conditions with the protective film 2301a, near the peak of the fulcrum member 2103, the crowning 2103a remains and an amorphous silicon film exists thinly at this time. The top part of the fulcrum member 2103 projected about 0.2 micrometer. There is an amorphous silicon film which remains by the 1st sacrifice layer 2802. As the 1st sacrifice layer, a polyimide film, a photosensitive organic layer, a resist film, a polycrystalline silicon film that are generally used in a semiconductor process, etc. can also be used besides the above. The etchback method by dry etching can also be used as the technique of flattening.
[0160]
Subsequently, the 2nd sacrifice layer 2803 is formed (Drawing 122).
The amorphous silicon film was included to the point of the fulcrum member 2103 by the sputtering method, and was made to deposit 0.1 micrometer.
[0161]
Next, the dielectric layer 2201 and the conductor layer 2202 of the plate-like member 2104 are formed (Drawing 123).
The silicon nitride film was made to deposit at 0.2 micrometer in thickness with plasma CVD method, and the aluminum system metal membrane used as the conductor layer 2202 which serves as a light reflex field was made to deposit by sputtering technology by a thickness of 0.05 micrometer succeedingly as a base material used as the dielectric layer 2201. Then, the above-mentioned metal membrane and the above-mentioned silicon nitride film were patternized by the photo-engraving process and the dry etching method, respectively. In order to leave the space for forming the regulating member 2102 in the peripheral edge part of the substrate 2101 at a next process, the dielectric layer 2201 is formed more smallish than the substrate 2101. The conductor layer 2202 is formed more smallish than it so that it may appear on the dielectric layer 2201.
[0162]
Next, the 3rd sacrifice layer 2804 is formed (Drawing 124).
By the sputtering method, 1 micrometer of amorphous silicone films were made to deposit, and were made into the 3rd sacrifice layer 2904. As the 3rd sacrifice layer, a polyimide film, a photosensitive organic layer, a resist film, a polycrystalline silicon film that are generally used in a semiconductor process, etc. can also be used besides the above.
[0163]
Next, the space which forms the regulating member 2102 is made (Drawing 125).
The portion which patternized simultaneously the 1st sacrifice layer, the 2nd sacrifice layer, and the 3rd sacrifice layer, and met the peripheral edge part of the substrate 2101 by the photo-engraving process and the dry etching method is removed, and the space for regulating member 2102 is formed. At this time, the size of the sacrifice layer to leave is made larger than the size of the dielectric layer 2201 so that the dielectric layer 2201 may not be exposed.
[0164]
Next, the regulating member 2102 is formed (Drawing 126).
A silicon oxide film was made to deposit at 0.8 micrometer in thickness with plasma CVD method, by photo-engraving process and the dry etching method, it patternized and the regulating member 2102 was formed. The regulating member 2102 is not restricted to form of a graphic display, and as shown in Drawings 113 and 115, various modification may occur.
[0165]
Finally, a sacrifice layer is removed (Drawing 127).
The 1st which remains thru/or the 3rd sacrifice layer, and 2802, 2803 and 2804 by wet etching technology. Etching removal was carried out through an opening and the optical deflection equipment 2100 with which a movable range of the plate-like member 2104 with a reflector was regulated by the substrate 2101, the regulating member 2102, and the fulcrum member 2103 in predetermined space was obtained.
[0166]
In this manufacturing method, a center section of the rear face of the plate-like member 2104 comes to combine with the relation between the fulcrum member 2103 and unevenness, Since it is in a position where whose center section a sideslip did not arise but was always fixed also when the plate-like member 2104 inclines in response to electrostatic attraction from the electrode 2301, accuracy comes improved by directional control of a reflected light when it uses as a micro mirror device.
[0167]
If a operation effect of this invention is described on the whole, since a plate-like member which carries out a role of a mirror will contact a slant face and a substrate and an angle of inclination will be decided, control of a deflection angle of a mirror is easy and stable. Since a plate-like member can be reversed at a high speed by impressing potential which is different in a fulcrum member in an electrode which counters as a center, speed of response is made quickly. Since a plate-like member does not have a fixed end, it twists, and it is not accompanied by modification of modification etc., but long-term degradation can drive by a low voltage few. Since a detailed and lightweight plate-like member can be formed by semiconductor manufacturing technology, there are few shocks by collision with a regulating member, and there is little long-term degradation. By opting for composition of a regulating member or a plate-like member arbitrarily, an ON/OFF ratio (a S/N ratio in picture equipment, a contrast ratio in Electronic Image Devices Division) of a reflected light can be improved. Since semiconductor manufacturing technology and equipment can be used, a miniaturization and integration are possible at low cost. An optical deflection of one axis and the biaxial direction is possible by arranging two or more electrodes focusing on a fulcrum member.
[0168]
[Effect of the Invention]

Since this invention is constituted as explained above, according to invention of Claim 1. Displacement arranges the plate shape component of the plate shape formed with the thin film which combines with the surface a reflective means to reflect incident light, and constitutes it in the state of freedom in the void formed between bamboo hat-shaped bamboo hat shape members the fulcrum member top on a substrate without fixing on a substrate, Since potential is given to the electrode which countered the circumference of the fulcrum member on a substrate with the plate shape component, and has been arranged, the reflecting direction of incident light is changed in one axis or the biaxial direction by the reflective means on the plate shape component inclined and laid on a fulcrum member and it was made to perform an optical deflection, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy — it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection method by which an operating environment is not restricted by low cost, either.

According to invention of Claim 2, the plate shape component of the plate shape formed with the thin film which combines with the surface a reflective means to reflect incident light, and constitutes it, Displacement arranges in the state of freedom in the void formed between bamboo hat-shaped bamboo hat shape members the fulcrum member top on a substrate without fixing on a substrate, Potential is given to the electrode which countered the circumference of the fulcrum member on a substrate with the plate shape component, and has been arranged, Since the reflecting direction of incident light was changed in one axis or the biaxial direction by the reflective means on the plate shape component inclined and laid on a fulcrum member, and potential which is different in two or more electrodes of each which the electrode countered the circumference of the fulcrum member on a substrate with the plate shape component, and were arranged is given and it was made to perform an optical deflection, Displacement or change at the high speed of a displacement direction, and direction of an inclination can also be controlled now for a plate shape component by the biaxial direction with high precision in the direction of the purpose, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier — it being easy, an operation being stable, and a response being also still quicker, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection method by which an operating environment is not restricted by low cost, either.

[0169]

According to invention of Claim 3, the plate shape component of the plate shape formed with the thin film which combines with the surface a reflective means to reflect incident light, and constitutes it, Displacement arranges in the state of freedom in the void formed between bamboo hat-shaped bamboo hat shape members the fulcrum member top on a substrate without fixing on a substrate, Potential is given to the electrode which countered the circumference of the fulcrum member on a substrate with the plate shape component, and has been arranged, Change the reflecting direction of incident light in one axis or the biaxial direction by the reflective means on the plate shape component inclined and laid on a fulcrum member, and. Since give potential which is different in an electrode, the slant face on a substrate is contacted in the plate shape component of the plate shape formed with the thin film which combines a reflective means with the surface and constitutes it, the reflecting direction of incident light is specified and changed in the position which contacts and it was made to perform an optical deflection, Distribute the shock at the time of contact by displacement of a plate shape component, and control of a displacement direction becomes easy, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier — it being easy, an operation being still more stable, and a response being also still quicker, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection method by which an operating environment is not restricted by low cost, either.

According to invention of Claim 4. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Since it consists of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component and the electrode was arranged, without fixing, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy — it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.

[0170]

According to invention of Claim 5. Incident light. A reflective means by which the reflector to reflect was monotonous and was formed. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Since it consists of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component and the electrode was arranged, without fixing, A reflecting direction is arranged and the light flux which entered into the light reflex field can be reflected. An optical change is attained only in the target reflecting direction, without diffusing a reflected light, Also when using optical deflection equipment for each optical information processing device, an image forming device, an image projection display device, an optical transmission device, etc., the influence on adjacent elements is inhibited, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier — it being easy, an operation being still more stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.

According to invention of Claim 6. Incident light. The reflective means formed with the aluminum system metal membrane to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination

composition. Since it consists of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component and the electrode was arranged, without fixing, Reflection performance is also good to serve also as the conductive area of a reflective means or a plate shape component formed in part at least, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not further restricted by low cost, either.

According to invention of Claim 7. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, counter the circumference of the fulcrum member on a substrate with the rear face of a plate shape component, and arrange an electrode, without fixing, and. Since it was made for a plate shape component to become the face shape of the part which touches a fulcrum member from the curved shape section of curved shape, It is controlled that positioning of the plate shape component to a fulcrum member becomes easy spontaneously, and a plate shape component contacts the bamboo hat shape member 5 side at the time of displacement of a plate shape component. the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- it being easy, an operation being still more stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had still few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.

[0171]

According to invention of Claim 8. Incident light. A reflective means to reflect. The void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate laid without an outside fixing the plate shape component which is a circle configuration with the plate shape formed with the thin film which is combined with the surface and constituted. Since it consists of a bamboo hat shape member of the bamboo hat form to form, the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component and the electrode was arranged, The reflected light reflected in the reflection region of the reflector of the reflective means combined with the plate shape component becomes circular, differing from the gap part of the adjacent pixel of the rectangle picture element shape by a rectangle plate shape component serving as a linear muscle by making dot form dotted with the gap part of an adjacent pixel by making 1 pixel in a described image forming device, an image projection device, etc. possessing optical deflection equipment into a circle configuration -- high -- a brilliance picture, [obtain and] the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation have few mechanical strengths also at the time of long term use, and driver voltage is low, and with saving resources, a miniaturization and integration are possible and by low cost. The optical deflection equipment with which an operating environment is not restricted, either can be provided now.

According to invention of Claim 9. Incident light. A reflective means to reflect. The void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate laid without fixing the plate shape component which consists of a silicon nitride film of the plate shape formed with the thin film which is combined with the surface and constituted. Since it consists of a bamboo hat shape member of the bamboo hat form to form, the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component and the electrode was arranged, A plate shape component has high dielectric breakdown voltage, and since the tolerance over the fatigue accompanied by long-term degradation, i.e., repetition displacement, is also high, not less than several 10-kHz high-speed operation of it becomes possible so that a light weight and a drive [in /-izing can be carried out / thin film / and / frequency high by that cause] are possible as much as possible, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- it being easy, an operation being still more stable, and a response being also still quicker, and, Without restricting the wavelength of the incident light to be used, change and degradation had still few mechanical strengths also at the time of long term use, still lower, with saving resources, a miniaturization and integration can be still more possible and driver voltage could provide the optical deflection equipment with which an operating environment is not further restricted by low cost, either.

[0172]

According to invention of Claim 10. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, counter the circumference of the fulcrum member on a substrate with the rear face of a plate shape component, and arrange an electrode, without fixing, and. Since a reflective means or a plate shape component has a conductive area which has conductivity and it was made for a conductive area to counter with an electrode, By making inter-electrode [two or more] produce potential difference arbitrarily, a plate shape component is displaced in the direction of the purpose by lower driver voltage, Or a displacement direction is changed succeedingly at high speed, Or direction of an inclination can be controlled now by the biaxial direction with high precision, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- it being easy, an operation being stable, and a response being also still quicker, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, still lower, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.

According to invention of Claim 11. Incident light. A reflective means to reflect. The void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate which consists of a hollow form part of the hollow form laid without fixing the plate shape component of the plate shape formed with the thin film which is combined with the surface and constituted. Since it consists of a bamboo hat shape member of the bamboo hat form to form, the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component and the electrode was arranged, The height of a bamboo hat shape member becomes low, the yield improves, and further, lead to the independence stability of the bamboo hat shape member itself, and a mechanical strength is raised, the controllability of the height of a void (G) can be improved with a manufacturing method -- driver voltage -- and, the structure and control which the controllability of reset voltage becomes good, change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had still few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.

[0173]

According to invention of Claim 12. Incident light. A reflective means to reflect. The void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate which consists of a silicon substrate which has a plane direction (100) laid without fixing the plate shape component of the plate shape formed with the thin film which is combined with the surface and constituted. Since it consists of a bamboo hat shape member of the bamboo hat form to form, the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component and the electrode was arranged, the structure and control which are simply formed in a complicated drive-system circuit in the same board, change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not further restricted by low cost, either.

According to invention of Claim 13. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, counter the circumference of the fulcrum member on a substrate with the rear face of a plate shape component, and arrange an electrode, without fixing, and. Since it was made for the face shape of the part which touches a plate shape component to be a circular shaped part, a fulcrum member, Reduce the touch area of a plate shape component and a fulcrum member, and the optical deflection of the biaxial direction becomes easy, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.

[0174]

According to invention of Claim 14. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, counter the circumference of the fulcrum member on a substrate with the rear face of a plate shape component, and arrange an electrode, without fixing, and. Since it was made for a fulcrum member to be a conical shape part which touches a plate shape component at a point, can strengthen the mechanical strength by the side of the substrate of the fulcrum part of a fulcrum member, and and displacement of a plate shape component, Since it is prescribed by the contact portion with the upper surface of the substrate in the end of a plate shape component, . A touch area is reduced as much as possible, and the adherence and contact electrification to the substrate 3 of a plate shape component can be controlled. It becomes possible easily to carry out tilt displacement of the plate shape component in the arbitrary directions corresponding to the direction which acts on electrostatic attraction since a fulcrum member has point form in the field in contact with a plate shape component, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- a response being also quick, and change and degradation having [it is easy and an operation is still more stable, and] still few mechanical strengths also at the time of long term use, without restricting the wavelength of the incident light to be used, and, Still lower, with saving resources, a miniaturization and integration can be possible and driver voltage can provide now the optical deflection equipment with which an operating environment is not restricted by low cost, either.

According to invention of Claim 15. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, counter the circumference of the fulcrum member on a substrate with the rear face of a plate shape component, and arrange an electrode, without fixing, and. Since it was made for the field which touches a plate shape component to be a rectangular rectangular form part, a fulcrum member, The fulcrum member tilt displacement to the short length direction of a fulcrum member, i.e., the tilt displacement by the electrostatic attraction of the plate shape component of 1 shaft orientations, stabilizes and happens, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- it being easy, an operation being still more stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost,

either.
[0175]
According to invention of Claim 16. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, counter the circumference of the fulcrum member on a substrate with the rear face of a plate shape component, and arrange an electrode, without fixing, and. Since it was made for a fulcrum member to be a ridge form part which consists of form of the ridge which touches a plate shape component by a line, Reduce the ridge form part of a fulcrum member, and the touch area of a plate shape component, and the tilt displacement by the electrostatic attraction of the plate shape component of 1 shaft orientations is stabilized, and is caused, Since the ridge form part of a fulcrum member has a slant face, since displacement of strength and a plate shape component is prescribed by the contact portion with the upper surface of the substrate in the end of a plate shape component, the mechanical strength of a fulcrum member, A touch area is reduced as much as possible, and the adherence and contact electrification to the substrate of a plate shape component can be controlled, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- a response being also quick, change and degradation having still few mechanical strengths also at the time of long term use, and driver voltage being [it is easy and an operation is still more stable,] low, without restricting the wavelength of the incident light to be used, and with saving resources. A miniaturization and integration can be possible and the optical deflection equipment with which an operating environment is not restricted by low cost, either can be provided now.
According to invention of Claim 17. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, counter the circumference of the fulcrum member on a substrate with the rear face of a plate shape component, and arrange an electrode, without fixing, and. Since it can contact all over an electrode since it was made for a fulcrum member to have a slant face which touches a plate shape component, and a plate shape component can be displaced, distribute the shock at the time of contact and control of a displacement direction becomes easy, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- it being easy, an operation being still more stable, and a response being also still quicker, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.
[0176]
According to invention of Claim 18. Incident light. A reflective means to reflect. The void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member which consists of a silicon oxide film used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate laid without fixing the plate shape component of the plate shape formed with the thin film which is combined with the surface and constituted, or a silicon nitride film. Since it consists of a bamboo hat shape member of the bamboo hat form to form, the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component and the electrode was arranged, a fulcrum member is simple for the structure and control which a mechanical strength becomes strong, change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection -- it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had still few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.
According to invention of Claim 19. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, counter the circumference of the fulcrum member on a substrate with the rear face of a plate shape component, and arrange an electrode, without fixing, and. Since a bamboo hat shape member vacates a predetermined interval and arranged two or more bamboo hat shape members of each corresponding to the periphery of a plate shape component, The time required at the time of the etching removal of a sacrifice layer is shortened, and the yield also improves, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not further restricted by low cost, either.
[0177]
According to invention of Claim 20. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, counter the circumference of the fulcrum member on a substrate with the rear face of a plate shape component, and arrange an electrode, without fixing, and. Since the bamboo hat shape member was arranged to all the fields corresponding to the periphery of a plate shape component, It reduces that a plate shape component overflows and breaks down from the void which had the movable range restricted mechanically as much as possible, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- it being easy, an operation being still more stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had still few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.

According to invention of Claim 21. Incident light. A reflective means to reflect. The insulation of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate laid without fixing the plate shape component of the plate shape formed with the thin film which is combined with the surface and constituted. Since it consists of a bamboo hat shape member which consists of an insulator layer which it has, the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component and the electrode was arranged, Changing the potential of a plate shape component, since the electric charge of the plate shape component which has floated electrically does not move via a bamboo hat shape member even when a plate shape component contacts a bamboo hat shape member is controlled, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- it being easy, an operation being still more stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.

[0178]

According to invention of Claim 22. Incident light. A reflective means to reflect. The void where displacement is arranged in the state of freedom in a plate shape component to the incoming beam of the bamboo hat form to form on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate laid without fixing the plate shape component of the plate shape formed with the thin film which is combined with the surface and constituted translucency. Since it consists of a bamboo hat shape member which consists of a translucency film which it has, the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component and the electrode was arranged, Since the reflected light from a field which laps with the bamboo hat shape member of the light reflex field of the reflector of the reflective means which combines with a plate shape component and is constituted can also make it contribute and the area and light volume of a reflected light in one element can be made to increase, ON light volume increases, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- it being easy, an operation being still more stable, and a response being also still quicker, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.

According to invention of Claim 23. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member which consists of a silicon oxide film of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate laid without fixing, and the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component. Since the electrode was arranged, it is compatible in insulation with a high bamboo hat shape member, and high translucency, and production of a miniaturization and integration is also attained, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- it being easy, an operation being still more stable, and a response being also still quicker, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be still more possible and driver voltage could provide the optical deflection equipment with which an operating environment is not further restricted by low cost, either. According to invention of Claim 24. Incident light. A reflective means to reflect. The void where displacement is arranged in the state of freedom in a plate shape component to the incoming beam of the bamboo hat form to form on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate laid without fixing the plate shape component of the plate shape formed with the thin film which is combined with the surface and constituted a light sheilding. Since it consists of a bamboo hat shape member which consists of a shading film which it has, the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component and the electrode was arranged, A reflection in the direction which is not expected the light flux which entered into the bamboo hat shape member is controlled, the stray light of the optical deflection to a target direction falls, and OFF light volume is controlled, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- it being easy, an operation being still more stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.

[0179]

According to invention of Claim 25. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member which consists of a chromium oxide film of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate laid without fixing, and the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component. Since the electrode was arranged, it is compatible in insulation with a high bamboo hat shape member, and a high light sheilding, and production of a miniaturization and integration is attained, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- it being easy, an operation being still more stable, and a response being also still quicker, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not further restricted by low cost, either.

According to invention of Claim 26. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, counter the circumference of the fulcrum member on a substrate with the rear face of a plate shape component, and arrange an electrode, without fixing, and. Since the electrode consisted of two or more electrodes of each and it was made for

the plate shape component to have floated electrically, Displace a plate shape component in the direction of the purpose, and a displacement direction is changed succeedingly at high speed, Direction of the inclination of a plate shape component is controlled by the biaxial direction with high precision by producing potential difference arbitrarily, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- it being easy, an operation being stable, and a response being also still quicker, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.

[0180]

According to invention of Claim 27. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, counter the circumference of the fulcrum member on a substrate with the rear face of a plate shape component, and arrange an electrode, without fixing, and. two or more electrodes of each which have arranged the electrode on the rear face of a plate shape component, and the slant face which countered -- from, since it became and was made for the plate shape component to have floated electrically, Can drive displacement of a plate shape component by the low voltage more, and the shock at the time of contact of a plate shape component is distributed, Displace a plate shape component in the direction of the purpose, and a displacement direction is changed succeedingly at high speed, Direction of the inclination of a plate shape component is controlled by the biaxial direction with high precision by producing potential difference arbitrarily, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are still easier -- it being easy, an operation being stable, and a response being also still quicker, and, Without restricting the wavelength of the incident light to be used, change and degradation have still few mechanical strengths also at the time of long term use, and driver voltage is still lower, and with saving resources, a miniaturization and integration are possible and by low cost. The optical deflection equipment with which an operating environment is not restricted, either can be provided now.

According to invention of Claim 28. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, counter the circumference of the fulcrum member on a substrate with the rear face of a plate shape component, and arrange an electrode, without fixing, and. Since the one-dimensional optical deflection array arranged to one-dimensional array form was formed, the structure and control which can be used for the latent image formation means in an image forming device, etc. and which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.

[0181]

According to invention of Claim 29. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate to lay, counter the circumference of the fulcrum member on a substrate with the rear face of a plate shape component, and arrange an electrode, without fixing, and. Since the two-dimensional optical deflection array arranged to two-dimensional array form was formed, . It can be used for the optical switch means in an image projection display device, etc. the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the optical deflection equipment with which an operating environment is not restricted by low cost, either.

According to invention of Claim 30, the plate shape component of the plate shape formed with the thin film which combines a reflective means with the surface and constitutes it via the 1st sacrifice layer that formed the fulcrum member and the electrode, and deposited and carried out flattening on the substrate is formed, Since the 1st sacrifice layer and 2nd sacrifice layer were removed after patternizing a bamboo hat shape member to the position which patternized the 2nd deposited sacrifice layer, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the manufacturing method of the optical deflection equipment with which an operating environment is not restricted by low cost, either.

According to invention of Claim 31, a fulcrum member and an electrode are formed on a substrate, The plate shape component which consists of a curved shape section of the curved shape formed with the thin film which combines a reflective means with the surface and constitutes it via the 3rd sacrifice layer that the fulcrum member was made to project and was deposited, was deposited on the 1st sacrifice layer that carried out flattening in piles, and carried out flattening to it is formed, Since the 1st sacrifice layer, 2nd sacrifice layer, and 3rd sacrifice layer were removed after patternizing a bamboo hat shape member to the position which patternized the 2nd deposited sacrifice layer, If it controls and puts in another way that a center and ****** become possible about a curved shape section at the time of displacement of a plate shape component, and a plate shape component shifts when a plate shape component carries out tilt displacement with electrostatic attraction, Positioning of the plate shape component to a fulcrum member becomes easy spontaneously, and it controls that a plate shape component contacts the side of a bamboo hat shape member at the time of displacement of a plate shape component, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- it being easy, an operation being still more stable, and a response being also quick, and, Without restricting the

wavelength of the incident light to be used, change and degradation have still few mechanical strengths also at the time of long term use, and driver voltage is low, and with saving resources, a miniaturization and integration are possible and by low cost. The manufacturing method of the optical deflection equipment with which an operating environment is not restricted, either can be provided now.

[0182]

According to invention of Claim 32, the fulcrum member and electrode which become depressed on a substrate, become depressed with a form part, and become form circles from a slant face are formed, The plate shape component of the plate shape formed with the thin film which accumulates, combines a reflective means with the surface and constitutes it via the 1st sacrifice layer that carried out flattening is formed, Since the 1st sacrifice layer and 2nd sacrifice layer were removed after patternizing a bamboo hat shape member to the position which patternized the 2nd deposited sacrifice layer, The height of a bamboo hat shape member becomes low, and leads to the independence stability of the bamboo hat shape member itself, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy — it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had still few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the manufacturing method of the optical deflection equipment with which an operating environment is not restricted by low cost, either.

According to invention of Claim 33, the plate shape component of the plate shape formed with the thin film which combines a reflective means with the surface and constitutes it via the 1st sacrifice layer that formed the fulcrum member and the electrode, and deposited and carried out flattening on the substrate is formed, Since the 1st sacrifice layer and 2nd sacrifice layer were removed from the predetermined interval which has vacated and arranged between each bamboo hat shape member of the plurality of a bamboo hat shape member after patternizing a bamboo hat shape member to the position which patternized the 2nd deposited sacrifice layer, the structure and control which etching of a sacrifice layer shortens, change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy — it being easy, an operation being stable, and a response being also quick, and, Without restricting the wavelength of the incident light to be used, change and degradation had few mechanical strengths also at the time of long term use, low, with saving resources, a miniaturization and integration can be possible and driver voltage could provide the manufacturing method of the optical deflection equipment with which an operating environment is not further restricted by low cost, either.

[0183]

According to invention of Claim 34. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate laid without fixing, and the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component. Since it was made to drive respectively the optical deflection equipment which has arranged the electrode independently by an independent drive means, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy — it being easy, an operation being stable, and a response being also quick, and, Driver voltage low [without restricting the wavelength of the incident light to be used / change and degradation have few mechanical strengths also at the time of long term use, and] with saving resources. a miniaturization and integration are possible, the optical deflection equipment with which an operating environment is not restricted by low cost, either is provided, and structure and control are easy — it can be easy and the optical information processing device possessing the optical deflection equipment which controls the reflected light from the adjacent elements generated when the stray light and a reflecting direction are in disorder can be provided now.

. According to invention of Claim 35, on the picture support which is held rotatable and supports a formed image, perform optical writing and form a latent image. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate laid without fixing, and the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component. Since the toner image formed by the developing means which develops the latent image formed by the above-mentioned optical deflection equipment of the latent image formation means which consists of optical deflection equipment which has arranged the electrode, and forms a toner image is transferred to a transferred object by a transfer means and the picture was formed, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy — it being easy, an operation being stable, and a response being also quick, and, change and degradation have few mechanical strengths also at the time of long term use, a miniaturization and integration are possible with saving resources, driver voltage is low and structure and control are [the optical deflection equipment with which an operating environment is not restricted by low cost, either is provided, and] easy [without restricting the wavelength of the incident light to be used,] — easy — and the stray light. Control the reflected light from the adjacent elements generated when a reflecting direction is in disorder, the ON/OFF control at the time of optical writing is good, and high-speed operation is possible, and the high speed which long-term reliability is high and drives by the low voltage and whose S/N ratio can also improve — high — the image forming device possessing the optical deflection equipment which forms a brilliance picture can be provided now.

[0184]

. According to invention of Claim 36, change the reflecting direction of the incident light of image projection data, perform an optical deflection, and project and display a picture. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate laid without fixing, and the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component. Since the optical switch means which consists of optical deflection equipment which has arranged the electrode projects a picture on a projection screen and it was made to display on it, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy — it being

easy, an operation being stable, and a response being also quick, and, Driver voltage low [without restricting the wavelength of the incident light to be used / change and degradation have few mechanical strengths also at the time of long term use, and] with saving resources. a miniaturization and integration are possible, the optical deflection equipment with which an operating environment is not restricted by low cost, either is provided, and structure and control are easy — it being easy and, And reliability control the reflected light from the adjacent elements generated when the stray light and a reflecting direction are in disorder, and the ON/OFF control at the time of light-and-darkness control of a picture is good, and possible [high-speed operation], and long-term is high, and it drives by the low voltage. Since the contrast ratio also improved, though it was high-intensity, the image projection display device possessing the optical deflection equipment which projects and displays the high definition picture which has high contrast could be provided.

According to invention of Claim 37, change the reflecting direction of the incident light of the lightwave signal from a lightwave signal input means which inputs a lightwave signal in one axis or the biaxial direction, and an optical deflection is performed, . Determine the optical path of each lightwave signal. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate laid without fixing, and the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component. Since it was made to output the lightwave signal from the optical switch means which consists of optical deflection equipment which has arranged the electrode by a lightwave signal output means, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- it being easy, an operation being stable, and a response being also quick, and, Driver voltage low [without restricting the wavelength of the incident light to be used / change and degradation have few mechanical strengths also at the time of long term use, and] with saving resources. a miniaturization and integration are possible, the optical deflection equipment with which an operating environment is not restricted by low cost, either is provided, and structure and control are easy -- it being easy, and the reflected light from the adjacent elements generated when the stray light and a reflecting direction are in disorder being controlled, and the optical deflection of the biaxial direction being performed correctly easily, and, Control of selection of each port is good, and control the stray light to an adjacent port and high-speed optical path switching is possible, Since long-term reliability was high, it drove by the low voltage and integration was completed on the same substrate, though it was small, the optical transmission device possessing the optical deflection equipment which determines the optical path of a lightwave signal with little malfunction, and outputs and transmits it at high speed could be provided.

[0185]

According to invention of Claim 38, change the reflecting direction of the incident light of the lightwave signal from a lightwave signal input means which inputs a lightwave signal in one axis or the biaxial direction, and an optical deflection is performed, . Determine the optical path of each lightwave signal. Incident light. A reflective means to reflect. On the surface. The plate shape component of the plate shape formed with the thin film which carries out combination composition. Consist of a bamboo hat shape member of the bamboo hat form which forms the void where displacement is arranged in the state of freedom in a plate shape component on the fulcrum member used as the fulcrum at the time of displacement of the inclining plate shape component on the substrate laid without fixing, and the circumference of the fulcrum member on a substrate is countered with the rear face of a plate shape component. Since it was made to output the lightwave signal from the optical switch means which consists of two or more steps of pieces of optical deflection equipment which has arranged the electrode by a lightwave signal output means, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy — it being easy, an operation being stable, and a response being also quick, and, Driver voltage low [without restricting the wavelength of the incident light to be used / change and degradation have few mechanical strengths also at the time of long term use, and] with saving resources. a miniaturization and integration are possible, the optical deflection equipment with which an operating environment is not restricted by low cost, either is provided, an optical deflection angle is large, and structure and control are easy — the reflected light from the adjacent elements generated when it is easy and the stray light and a reflecting direction are in disorder, [control and] Control of the performing [correctly]-easily-optical deflection of biaxial direction result and selection of each port is good, and control the stray light to an adjacent port and high-speed optical path switching is possible, Since long-term reliability was high, it drove by the low voltage and integration was completed on the same substrate, though it was small, the optical transmission device possessing the optical deflection equipment which determines the optical path of a lightwave signal with little malfunction, and outputs and transmits it at high speed could be provided.

It becomes possible easily to carry out tilt displacement of the plate shape component in the arbitrary directions corresponding to the direction which acts on electrostatic attraction since a fulcrum member has point form in the field in contact with a plate shape component according to invention of Claims 39-43, the structure and control which change the reflecting direction of incident light in one axis or the biaxial direction, and perform an optical deflection are easy -- it is easy.

It becomes possible easily to carry out tilt displacement of the plate shape component in the arbitrary directions corresponding to the direction which acts on electrostatic attraction since a fulcrum member has point form in the field in contact with a plate shape component according to invention of Claims 44-57, the structure and control which change the reflecting direction of incident light in the direction of plural shafts, and perform an optical deflection are easy -- it is easy.

[0186]

According to invention of Claim 58, since the part where a plate-like member and a fulcrum member contact mutually is conductivity, the contact resistance between both can be reduced and a low voltage drive is possible. Suppose that control of the deflection angle of a mirror is easy, and that it is stable by performing the inclination centering on the fulcrum of the plate-like member centering on a fulcrum member until it contacts a substrate. A hinge which torsion or modification produces since the plate-like member does not have a fixed end, or a fixed-beam part does not exist, but since there is little degradation of brittle degradation in long-term use, etc. and the power of eye others [the part which does not produce modification, and] is unnecessary, it can drive by the low voltage. Since a plate-like member can be mostly positioned at arbitrary space by a regulating member, reset voltage at the time of a reset action can be made low as much as possible. It can drive stably by the low voltage further by making potential of a plate-like member into arbitrary potential via a fulcrum member.

[0187]

According to invention of Claim 59, the maximum use of the entering light flux can be carried out.

Since according to invention of Claim 60 a plate-like member has a component which has a dielectric and the potential of a

plate-like member can be held also when it becomes possible to hold the potential of a plate-like member to the component which has a dielectric and contact of a plate-like member and a fulcrum member is severed momentarily, the inclination of a plate-like member can be driven stably.
According to invention of Claim 61, it becomes easy to hold the potential of a plate-like member to the component which has a dielectric, and since it is possible to carry out dielectricity more efficiently, the inclination of a plate-like member can be driven more by the low voltage to stability.
[0188]
According to invention of Claim 62, since it has high insulation and has a high mechanical strength, securing high specific inductive capacity, the electric short circuit of a plate-like member and an electrode can be controlled, and the destruction at the time of displacement of a plate-like member can be controlled.
According to invention of Claim 63, since two or more electrodes formed in the substrate and the conductive part of the crowning of a fulcrum member were separated electrically, as for the potential given to a plate-like member, the electrode on a substrate should become independent.
[0189]
According to invention of Claim 64, when the potential difference beyond a specified value is given between a plate-like member and an electrode, since the part has countered at least, both can use electrostatic attraction among both.
According to invention of Claim 65, a plate-like member can be displaced in all the directions by making the crowning of a fulcrum member into a point of contact.
[0190]
According to invention of Claim 66, a displacement direction can be made to decide stably by contacting the plate-like member which can be displaced in all the directions to either of two or more slant faces.
Since a plate-like member makes a fulcrum member and line contact according to invention of Claim 67, it is limited to displacement of only the 2-way centering on a line of contact, but since it is dramatically extremely stable when using for simple equipment, accurate equipment is obtained.
[0191]
Since the electrode is asymptotically close to a plate-like member according to invention of Claim 68, displacement of the plate-like member by electrostatic attraction can be caused also by lower potential difference.
According to invention of Claim 69, while a displacement condition is dramatically stabilized since the whole rear face of a plate-like member contacts a slant face when a plate-like member is displaced, the shock at the time of contact can be distributed and, thereby, optical deflection equipment with little long-term strength deterioration can be provided.
[0192]
According to invention of Claim 70, since the whole surface on the rear face of a plate-like member contacts only a convex part rather than contacts a slant face also when a plate-like member is in a contact state on a slant face, a touch area can be reduced, the adherence to the substrate of a plate-like member can be controlled, and the optical deflection equipment which has high reliability can be provided.
In [according to invention of Claim 71] an optical deflection array, Since the atmosphere near the plate-like member is a vacuum mostly and lift with the gas in atmosphere is not received at the time of displacement of a plate-like member, the problem of the inflow of the gas between the adjoining elements and an outflow can be solved, and the interaction of displacement of the plate-like member between elements can be lost. In optical deflection equipment, when it package-izes so that the circumference of equipment may be covered with covering, the gas of atmosphere serves as viscous resistance to change of the rapid inclination of the plate-like member by voltage impressing, and it can prevent few response delays arising.
[0193]
According to invention of Claim 72, the moisture in atmosphere can be reduced and the adherence in a point of contact when a plate-like member carries out tilt displacement and it contacts to a substrate by that cause, and the point of contact of a fulcrum member and a plate-like member can be controlled.
According to invention of Claim 73, the displacement direction of a plate-like member can be changed to a reverse side by changing the potential which changes the relation between the maximum of potential, and the minimum given to the electrode which counters on both sides of the crowning of a fulcrum member, or is given to a plate-like member between a maximum side and the minimum side. Much more displacement directions can be obtained by changing the maximum potential given to an electrode or minimum potential to contiguity and other electrodes.
[0194]
It becomes possible to pinch one or more electrodes in the state where it floated electrically between the electrode which gives maximum potential, and the electrode which gives minimum potential when making especially the number of electrodes into six or more pieces according to invention of Claim 74, high potential difference does not arise among adjoining electrodes, and the stable operation is obtained.
According to invention of Claim 75, since the curvature in the mirror surface by the remaining stress of a plate-like member can be controlled easily, reflected lights other than a target direction can be controlled, and the S/N ratio of reflected light quantity can be raised.
[0195]
According to invention of Claim 76, since the reflectance of an aluminum system metal membrane is good, reflection performance as a mirror can be made high. Since the electrical resistance of an aluminum system metal membrane is low, the potential from a fulcrum member can be given effectively and it can drive by the low voltage.
[0196]
According to invention of Claim 77, it becomes possible to carry out drive controlling of two or more elements that it is simultaneous and independently, and to carry out an optical deflection.
According to invention of Claim 78, light-and-darkness control of the pixel by ON/OFF control of an optical switch is good, and can control the stray light, and high-speed operation is possible, Since long-term reliability can be high, it can drive by the low voltage and a contrast ratio can be improved, though it is high-intensity, the high definition image projection display device which has a high contrast ratio can be provided. According to invention of Claim 79, when a plate-like member contacts the fulcrum member formed in the substrate face, gravity acts on a plate-like member, but gravity acts uniformly and the inclination of the plate-like member to the direction of which electrode does not have a bias, either. Thereby, when a plate-like member carries out tilt displacement, the further stable operation, i.e., the existing operation of long term reliability or repeated reproducibility,

can be obtained.
[0197]
since according to invention of Claim 80 the ON/OFF control at the time of optical writing is good, and can control the stray light, and high-speed operation can be possible, long-term reliability can be high, it can drive by the low voltage and a S/N ratio can be improved -- a high speed -- and -- high -- a brilliance image forming device can be provided.
According to invention of Claim 81, when a plate-like member contacts the fulcrum member formed in the substrate face, gravity acts on a plate-like member, but gravity acts uniformly and the inclination of the plate-like member to the direction of which electrode does not have a bias, either. Thereby, when a plate-like member carries out tilt displacement, the further stable operation, i.e., the existing operation of long term reliability or repeated reproducibility, can be obtained.
[0198]
According to invention of Claim 82, control of selection of two or more input/output port which receives one input/output port is good, Since the stray light to an adjacent port can be controlled, and high-speed optical path switching is possible, long-term reliability is high, it can drive by the low voltage and it can be integrated on the same substrate, though it is small, a high speed and an optical transmission device with little malfunction can be provided.
According to invention of Claim 83, control of selection of two or more input/output port of one input output section and two or more input/output port of the input output section of another side is good, Since the stray light to an adjacent port can be controlled, and high-speed optical path switching is possible, long-term reliability is high, it can drive by the low voltage and it can be integrated on the same substrate, though it is small, a high speed and an optical transmission device with little malfunction can be provided.
According to invention of Claim 84, when a plate-like member contacts the fulcrum member formed in the substrate face, gravity acts on a plate-like member, but gravity acts uniformly and the inclination of the plate-like member to the direction of which electrode does not have a bias, either. Thereby, when a plate-like member carries out tilt displacement, the further stable operation, i.e., the existing operation of long term reliability or repeated reproducibility, can be obtained.
[0199]
According to invention of Claim 85, high yield, high integration, and detailed optical deflection equipment can be manufactured on the same substrate. Since the optical deflection equipment of this invention can be manufactured minutely, the weight of a plate-like member can be reduced, a shock when a plate-like member collides with a regulating member by that cause at the time of standby, and a shock when a plate-like member contacts a substrate at the time of operation can be reduced, and the optical deflection equipment which has high reliability can be provided.
According to invention of Claim 86, high yield, high integration, and a detailed optical deflection array can be manufactured on the same substrate. Since the optical deflection array of this invention can be manufactured minutely, the weight of a plate-like member can be reduced, a shock when a plate-like member collides with a regulating member by that cause at the time of standby, and a shock when a plate-like member contacts a substrate at the time of operation can be reduced, and the optical deflection array which has high reliability can be provided.
[0200]
Since the convex part of arbitrary sizes can be formed according to invention of Claim 87, the optical deflection equipment which reduced the adsorption power of the plate-like member and controlled adherence and in which the stable drive is possible can be manufactured on the same substrate.
[0201]
According to invention of Claim 88, by the crowning of a cone being spherical, stress concentration is avoided and the stable operation is acquired.
[0202]
According to invention of Claim 89, the vertical angle of a cone can be enlarged and top intensity stability is obtained.
[0203]
According to invention of Claim 90, since there is no tip form in the crowning of a fulcrum member, danger, such as breakage of the fulcrum member by stress concentration, decreases more.
[0204]
According to invention of Claim 91, top intensity stability is obtained.
[0205]
according to invention of Claim 92 -- manufacture -- an easy fulcrum member is obtained.
[0206]
Also when a plate-like member is in a contact state on a slant face in the optical deflection equipment using the fulcrum member of the polygonal-pyramid form which carries out a plate-like member and point contact according to invention of Claim 93, the whole surface on the rear face of a plate-like member does not contact a slant face, Since only a convex part is contacted, a touch area can be reduced, the adherence to the substrate of a plate-like member can be controlled, and the optical deflection equipment which has high reliability can be provided. Creation of a photo mask becomes easy when patterning a convex part.
[0207]
According to invention of Claim 94, in the optical deflection equipment using the fulcrum member of the polygonal-pyramid form which carries out a plate-like member and point contact, the adherence phenomenon of the plate-like member to the convex part on the slant face of a fulcrum member can be prevented.
[0208]
Also when a plate-like member is in a contact state on a slant face in the optical deflection equipment using the fulcrum member of the square pillar form which carries out a plate-like member and line contact according to invention of Claim 95, the whole surface on the rear face of a plate-like member does not contact a slant face, Since only a convex part is contacted, a touch area can be reduced, the adherence to the substrate of a plate-like member can be controlled, and the optical deflection equipment which has high reliability can be provided. Creation of a photo mask becomes easy, and also the possibility of electrification in a convex part becomes low, and the probability of adherence of a plate-like member becomes low.
[0209]
According to invention of Claim 96, in the optical deflection equipment using the fulcrum member of the square pillar form which carries out a plate-like member and line contact, the adherence phenomenon of the plate-like member to the convex part on the slant face of a fulcrum member can be prevented.
[0210]

According to invention of Claim 97, the maximum use of the entering light flux can be carried out.
[0211]
Since according to invention of Claim 98 a plate-like member has a component which has a dielectric and the potential of a plate-like member can be held also when it becomes possible to hold the potential of a plate-like member to the component which has a dielectric and contact of a plate-like member and a fulcrum member is severed momentarily, the inclination of a plate-like member can be driven stably.
[0212]
According to invention of Claim 99, it becomes easy to hold the potential of a plate-like member to the component which has a dielectric, and since it is possible to carry out dielectricity more efficiently, the inclination of a plate-like member can be driven more by the low voltage to stability.
[0213]
According to invention of Claim 100, since it has high insulation and has a high mechanical strength, securing high specific inductive capacity, the electric short circuit of a plate-like member and an electrode can be controlled, and the destruction at the time of displacement of a plate-like member can be controlled.
[0214]
According to invention of Claim 101, since two or more electrodes formed in the substrate and the conductive part of the crowning of a fulcrum member were separated electrically, as for the potential given to a plate-like member, the electrode on a substrate should become independent.
[0215]
According to invention of Claim 102, when the potential difference beyond a specified value is given between a plate-like member and an electrode, since the part has countered at least, both can use electrostatic attraction among both.
[0216]
According to invention of Claim 103, sufficient intensity comes to be obtained to stress etc. by enlarging the plane-of-composition product of the portion which a regulating member joins to a substrate by an extended base.
[0217]
According to invention of Claim 104, since make it in agreement, it is made to unify and the position of the regulating member of two pieces of the optical deflection equipment which adjoins each other mutually [of two or more optical deflection equipment arranged to array form] is formed, stabilization of the intensity of a regulating member is obtained.
[0218]
According to invention of Claim 105, the utilization efficiency of area becomes the maximum and it can be considered as the compound regulating member which shared the regulating member of each other in all the adjoining optical deflection equipment.
[0219]
According to invention of Claim 106, also in a position without adjoining optical deflection equipment, since the plane-of-composition product which a regulating member joins to a substrate can be enlarged, the intensity where the regulating member was stabilized is obtained.
[0220]
According to invention of Claim 107, in the base of the compound regulating member shared in two adjoining pieces of optical deflection equipment, the intensity stable since the plane-of-composition product with a substrate was made greatly is obtained.
[0221]
According to invention of Claim 108, in the straight part of the compound regulating member shared in two adjoining pieces of optical deflection equipment, the intensity stable since the plane-of-composition product with a substrate was made greatly is obtained.
[0222]
According to invention of Claim 109, high yield, high integration, and detailed optical deflection equipment can be manufactured on the same substrate. Since the optical deflection equipment of this invention can be manufactured minutely, the weight of a plate-like member can be reduced, a shock when a plate-like member collides with a regulating member by that cause at the time of standby, and a shock when a plate-like member contacts a substrate at the time of operation can be reduced, and the optical deflection equipment which has high reliability can be provided.
[0223]
According to invention of Claim 110, the center section of the rear face of a plate-like member comes to combine by the relation between a fulcrum member and unevenness, Since it is in the position where whose center section a sideslip did not arise but was always fixed also when a plate-like member inclines in response to electrostatic attraction from an electrode, accuracy comes improved by the directional control of a reflected light when it uses as a micro mirror device.
[0224]
According to invention of Claim 111, high yield, high integration, and a detailed optical deflection array can be manufactured on the same substrate. Since the optical deflection array of this invention can be manufactured minutely, the weight of a plate-like member can be reduced, a shock when a plate-like member collides with a regulating member by that cause at the time of standby, and a shock when a plate-like member contacts a substrate at the time of operation can be reduced, and the optical deflection array which has high reliability can be provided.
[0225]
According to invention of Claim 112, in an optical deflection array the center section of the rear face of a plate-like member, Since it is in the position where whose center section a sideslip did not arise but was always fixed also when it comes to combine by the relation between a fulcrum member and unevenness and a plate-like member inclines in response to electrostatic attraction from an electrode, accuracy comes improved by the directional control of a reflected light when it uses as a micro mirror device.
[Brief Description of the Drawings]
[Drawing 1]It is an A-A line sectional view of drawing 2 explaining the optical deflection equipment concerning a 1st embodiment of this invention.
[Drawing 2]It is a top view of drawing 1.
[Drawing 3]It is an explanatory view explaining the state of the principal part of optical deflection equipment which shows a 1st embodiment of this invention.
[Drawing 4]It is an explanatory view explaining other states of the principal part of optical deflection equipment which show a 1st

embodiment of this invention.
[Drawing 5]It is a B-B line sectional view of drawing 6 explaining the principal part of the optical deflection equipment in which a 2nd embodiment of this invention is shown.
[Drawing 6]It is a top view of drawing 5.
[Drawing 7]It is an explanatory view explaining the principal part of the optical deflection equipment in which a 2nd embodiment of this invention is shown.
[Drawing 8]It is a figure explaining the fault of the modification of drawing 7.
[Drawing 9]It is a D-D line sectional view of drawing 10 explaining other principal parts of the optical deflection equipment in which a 3rd embodiment of this invention is shown.
[Drawing 10]It is a top view of drawing 9.
[Drawing 11]It is an expansion perspective view explaining the principal part of the optical deflection equipment in which a 3rd embodiment of this invention is shown.
[Drawing 12]It is an expansion perspective view explaining the principal part of the optical deflection equipment in which the modification of a 3rd embodiment of this invention is shown.
[Drawing 13]It is an E-E line sectional view of drawing 14 explaining the principal part of the optical deflection equipment in which a 4th embodiment of this invention is shown.
[Drawing 14]It is a top view of drawing 13.
[Drawing 15]It is an expansion perspective view explaining the principal part of the optical deflection equipment in which a 4th embodiment of this invention is shown.
[Drawing 16]It is an expansion perspective view explaining the principal part of the optical deflection equipment in which the modification of a 4th embodiment of this invention is shown.
[Drawing 17]It is a F-F line sectional view of drawing 18 explaining the principal part of the optical deflection equipment in which a 5th embodiment of this invention is shown.
[Drawing 18]It is a top view of drawing 17.
[Drawing 19]It is a G-G line sectional view of drawing 14 explaining the principal part of the optical deflection equipment in which a 6th embodiment of this invention is shown.
[Drawing 20]It is a top view of drawing 19.
[Drawing 21]It is an expansion perspective view explaining the principal part of the optical deflection equipment in which a 6th embodiment of this invention is shown.
[Drawing 22]It is an expansion perspective view explaining the principal part of the optical deflection equipment in which the modification of a 6th embodiment of this invention is shown.
[Drawing 23]It is a H-H line sectional view of drawing 24 explaining the principal part of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 24]It is a top view of drawing 23.
[Drawing 25]It is an I-I line sectional view of drawing 26 explaining the principal part of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 26]It is a top view of drawing 25.
[Drawing 27]It is a top view explaining other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 28]It is a J-J line sectional view of drawing 27 explaining operation of other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 29]It is a J-J line sectional view of drawing 27 explaining operation of everything but other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 30]It is a K-K line sectional view of drawing 27 explaining operation of everything but other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 31]It is a J-J line sectional view of drawing 27 explaining operation of everything but other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 32]It is a K-K line sectional view of drawing 27 explaining operation of everything but other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 33]It is a J-J line sectional view of drawing 27 explaining operation of everything but other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 34]It is a K-K line sectional view of drawing 27 explaining operation of everything but other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 35]It is a L-L line sectional view of drawing 27 explaining generating of the electrostatic force in the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 36]It is a P-P line sectional view of drawing 37 explaining the principal part of the optical deflection equipment in which an 8th embodiment of this invention is shown.
[Drawing 37]It is a top view of drawing 36.
[Drawing 38]It is a Q-Q line sectional view of drawing 39 explaining the principal part of the optical deflection equipment in which a 9th embodiment of this invention is shown.
[Drawing 39]It is a top view of drawing 38.
[Drawing 40]It is a R-R line sectional view of drawing 41 explaining the principal part of the optical deflection equipment in which a 10th embodiment of this invention is shown.
[Drawing 41]It is a top view of drawing 40.
[Drawing 42]It is a S-S line sectional view of drawing 43 explaining the principal part of the optical deflection equipment in which an 11th embodiment of this invention is shown.
[Drawing 43]It is a top view of drawing 42.
[Drawing 44]It is an explanatory view explaining the principal part of the optical deflection equipment in which an 11th embodiment of this invention is shown.
[Drawing 45]It is a T-T line sectional view of drawing 46 explaining the principal part of the optical deflection equipment in which a 12th embodiment of this invention is shown.
[Drawing 46]It is a top view of drawing 45.

[Drawing 47]It is a U-U line sectional view of drawing 48 explaining the principal part of the optical deflection equipment in which a 13th embodiment of this invention is shown.
[Drawing 48]It is a top view of drawing 47.
[Drawing 49]It is an explanatory view explaining the optical deflection equipment in which a 14th embodiment of this invention is shown.
[Drawing 50]It is an explanatory view explaining the optical deflection equipment in which a 15th embodiment of this invention is shown.
[Drawing 51]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 52]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 53]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 54]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 55]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 56]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 57]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 58]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 59]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 60]It is an explanatory view explaining the process of other principal parts of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 61]It is an explanatory view explaining the process of other principal parts of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 62]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 63]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 64]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 65]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 66]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 67]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 68]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 69]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 70]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 71]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 72]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 73]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 74]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 75]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 76]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 77]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 78]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 79]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 80]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 81]It is an explanatory view explaining the image forming device possessing the optical deflection equipment shown in the embodiment of this invention.
[Drawing 82]It is an explanatory view explaining the image projection display device possessing the optical deflection equipment shown in the embodiment of this invention.
[Drawing 83]It is an explanatory view explaining the optical transmission device possessing the optical deflection equipment

shown in the embodiment of this invention.
[Drawing 84]It is a top view for explaining the principal part of the optical deflection equipment in which a 16th embodiment of this invention is shown.
[Drawing 85]It is an A-A' line sectional view of drawing 84.
[Drawing 86]It is a top view for explaining the principal part of the optical deflection equipment in which a 17th embodiment of this invention is shown.
[Drawing 87]It is an A-A' line sectional view of drawing 86.
[Drawing 88]It is a top view for explaining the principal part of the optical deflection equipment in which an 18th embodiment of this invention is shown.
[Drawing 89]It is a top view for explaining the principal part of the optical deflection equipment in which a 19th embodiment of this invention is shown.
[Drawing 90]It is an A-A' line sectional view of drawing 89.
[Drawing 91]It is a figure explaining a 20th embodiment of this invention.
[Drawing 92]It is a figure explaining a 21st embodiment of this invention.
[Drawing 93]It is a figure explaining a 22nd embodiment of this invention.
[Drawing 94]It is a figure explaining a 23rd embodiment of this invention.
[Drawing 95]It is a figure showing the modification of the fulcrum member applied to a 23rd embodiment.
[Drawing 96]It is a figure explaining a 24th embodiment of this invention.
[Drawing 97]It is a figure explaining the 25th ********** of this invention.
[Drawing 98]It is a figure explaining the 26th ********** of this invention.
[Drawing 99]It is a sectional view of the D-D' line at the time of a reset action of the optical deflection equipment 2100 in drawing 98.
[Drawing 100]It is a figure explaining a 27th embodiment of this invention.
[Drawing 101]It is a figure explaining a 28th embodiment of this invention.
[Drawing 102]It is a figure explaining a 29th embodiment of this invention.
[Drawing 103]It is a figure explaining the example which applied the optical deflection array 1200 of this invention to the image projection display device.
[Drawing 104]It is a figure showing the example which applied the optical deflection array 1200 of this invention to image forming devices, such as a copying machine.
[Drawing 105]It is a figure showing the example which applied the optical deflection array 1200 of this invention to the optical transmission device.
[Drawing 106]It is a figure showing the optical deflection equipment 2100 of this invention, or the manufacturing process of the optical deflection array 1200.
[Drawing 107]It is a figure showing the process of forming the convex part of the slant face of the 24th embodiment.
[Drawing 108]It is a figure for explaining the form of a fulcrum member.
[Drawing 109]It is a figure for explaining the form of a fulcrum member.
[Drawing 110]It is a figure to the convex part in a 25th embodiment of this invention showing a modification embodiment.
[Drawing 111]It is a figure to the convex part in a 25th embodiment of this invention showing a modification embodiment.
[Drawing 112]It is a figure showing the embodiment of a regulating member.
[Drawing 113]It is a perspective view for describing the modification embodiment of a regulating member.
[Drawing 114]It is a sectional view of the optical deflection equipment using the regulating member of the modification embodiment.
[Drawing 115]It is a perspective view showing the further modification embodiment of a regulating member.
[Drawing 116]It is a sectional view showing the example of use of the regulating member of a modification embodiment.
[Drawing 117]It is a sectional view showing the example of use of the regulating member of a modification embodiment.
[Drawing 118]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Drawing 119]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Drawing 120]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Drawing 121]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Drawing 122]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Drawing 123]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
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[Drawing 125]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Drawing 126]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Drawing 127]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Explanations of letters or numerals]
0 Optical deflection equipment
1 Reflective means
1a Reflector
1b Aluminum system metal membrane
2 Plate shape component
2a Curved shape section

2b Conductive area
2c Silicon nitride film
2 d Contact portion
3 Substrate
3a Hollow form part
3b (100) The silicon substrate which has a plane direction
3c Insulator layer
4 Fulcrum member
4a Circular shaped part
$4a_1$ cylindrical shape
4b Conical shape part
$4b_1$ point form
$4b_2$ round shape
4c Rectangular form part
4 d, $4d_1$, $4d_2$, $4d_3$, a $4d_4$ slant face
4e Ridge form part
The shape of $4e_1$ linearity
$4e_2$ round shape
4 f Silicon oxide film
4 g Silicon nitride film
5 Bamboo hat shape member
$5a_{1-n}$ bamboo hat shape member
5b Insulator layer
5c Translucency film
5 d Silicon oxide film
5e Shading film
5 f Chromium oxide film
6 and $6a_1$, $6a_2$, $6a_3$, a $6a_4$ electrode
6b Protective film
7 Sacrifice layer
7a The 1st sacrifice layer
7b The 2nd sacrifice layer
7c The 3rd sacrifice layer
10 One-dimensional optical deflection array
20, 20a, and 20b Two-dimensional optical deflection array
100 Optical information processing device
101 Independent drive means
102 Light source
103 The 1st lens system
104 The 2nd lens system
105 A projection lens
106 A diaphragm
107 A rotary collar hole
108 A microlens array
200 An image forming device
201 Picture support
202 A latent image formation means
203 A developing means
204 A transfer means
205 An electrifying means
206 A fixing means
207 A delivery tray
208 A cleaning means
300 An image projection display device
301 An optical switch means
302 A projection screen
400 An optical transmission device
401 A lightwave signal input means
401a, $401a_1$, a $401a_2$ signal input transfer port
402 An optical switch means
402a, a $402a_1$ control device
403 A lightwave signal output means
403a, $403a_1$, a $403a_2$ signal output transfer port
(a_1) A substrate upper fulcrum component formation process
(a_2) An electrode formation process
(a_3) A protection film formation process
(a_4) The 1st sacrifice layer formation process
(a_5) A reflective means and a plate shape component formation process

(a_6) The 2nd sacrifice layer formation process
(a_7) A bamboo hat shape member patternizing process
(a_8) A bamboo hat shape member formation process
(a_9) Sacrifice layer removal process
(b_1) Substrate upper fulcrum component formation process
(b_2) Electrode formation process
(b_3) Protection film formation process
(b_4) 1st sacrifice layer formation process
(b_5) 3rd sacrifice layer formation process
(b_6) A reflective means and plate shape component formation process
(b_7) 2nd sacrifice layer formation process
(b_8) Bamboo hat shape member patternizing process
(b_9) Bamboo hat shape member formation process
(b_{10}) Sacrifice layer removal process
(c_1) A substrate top hollow form part and fulcrum member formation process
(c_2) Electrode formation process
(c_3) Protection film formation process
(c_4) 1st sacrifice layer formation process
(c_5) A reflective means and plate shape component formation process
(c_6) 2nd sacrifice layer formation process
(c_7) Bamboo hat shape member patternizing process
(c_8) Bamboo hat shape member formation process
(c_9) Sacrifice layer removal process
601 Fulcrum member
602 Conductive member
603 An insulating film
701 Convex part
800 Electrode
801 Insulating layer
802 Conductive layer
1200 Optical deflection array
1300 Image projection display device
1301 Optical switch means
1400 Image forming device
1402 Latent image formation means
1500 Optical transmission device
1502 Lightwave signal input part
1503 The 1st step of optical deflection array
1505 The 2nd step of optical deflection array
1507 Lightwave signal outputting part
2100 Optical deflection equipment
2101 Substrate
2102 Regulating member
2103 Fulcrum member
2104 Plate-like member
2201 Dielectric layer
2202 Conductor layer
2301 Electrode
2401 Fulcrum member
2402 Contacted part

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is an A-A line sectional view of drawing 2 explaining the optical deflection equipment concerning a 1st embodiment of this invention.
[Drawing 2]It is a top view of drawing 1.
[Drawing 3]It is an explanatory view explaining the state of the principal part of optical deflection equipment which shows a 1st embodiment of this invention.
[Drawing 4]It is an explanatory view explaining other states of the principal part of optical deflection equipment which show a 1st embodiment of this invention.
[Drawing 5]It is a B-B line sectional view of drawing 6 explaining the principal part of the optical deflection equipment in which a 2nd embodiment of this invention is shown.
[Drawing 6]It is a top view of drawing 5.
[Drawing 7]It is an explanatory view explaining the principal part of the optical deflection equipment in which a 2nd embodiment of this invention is shown.
[Drawing 8]It is a figure explaining the fault of the modification of drawing 7.
[Drawing 9]It is a D-D line sectional view of drawing 10 explaining other principal parts of the optical deflection equipment in which a 3rd embodiment of this invention is shown.
[Drawing 10]It is a top view of drawing 9.
[Drawing 11]It is an expansion perspective view explaining the principal part of the optical deflection equipment in which a 3rd embodiment of this invention is shown.
[Drawing 12]It is an expansion perspective view explaining the principal part of the optical deflection equipment in which the modification of a 3rd embodiment of this invention is shown.
[Drawing 13]It is an E-E line sectional view of drawing 14 explaining the principal part of the optical deflection equipment in which a 4th embodiment of this invention is shown.
[Drawing 14]It is a top view of drawing 13.
[Drawing 15]It is an expansion perspective view explaining the principal part of the optical deflection equipment in which a 4th embodiment of this invention is shown.
[Drawing 16]It is an expansion perspective view explaining the principal part of the optical deflection equipment in which the modification of a 4th embodiment of this invention is shown.
[Drawing 17]It is a F-F line sectional view of drawing 18 explaining the principal part of the optical deflection equipment in which a 5th embodiment of this invention is shown.
[Drawing 18]It is a top view of drawing 17.
[Drawing 19]It is a G-G line sectional view of drawing 14 explaining the principal part of the optical deflection equipment in which a 6th embodiment of this invention is shown.
[Drawing 20]It is a top view of drawing 19.
[Drawing 21]It is an expansion perspective view explaining the principal part of the optical deflection equipment in which a 6th embodiment of this invention is shown.
[Drawing 22]It is an expansion perspective view explaining the principal part of the optical deflection equipment in which the modification of a 6th embodiment of this invention is shown.
[Drawing 23]It is a H-H line sectional view of drawing 24 explaining the principal part of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 24]It is a top view of drawing 23.
[Drawing 25]It is an I-I line sectional view of drawing 26 explaining the principal part of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 26]It is a top view of drawing 25.
[Drawing 27]It is a top view explaining other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 28]It is a J-J line sectional view of drawing 27 explaining operation of other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 29]It is a J-J line sectional view of drawing 27 explaining operation of everything but other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 30]It is a K-K line sectional view of drawing 27 explaining operation of everything but other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 31]It is a J-J line sectional view of drawing 27 explaining operation of everything but other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 32]It is a K-K line sectional view of drawing 27 explaining operation of everything but other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 33]It is a J-J line sectional view of drawing 27 explaining operation of everything but other principal parts of the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 34]It is a K-K line sectional view of drawing 27 explaining operation of everything but other principal parts of the optical

deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 35]It is a L-L line sectional view of drawing 27 explaining generating of the electrostatic force in the optical deflection equipment in which a 7th embodiment of this invention is shown.
[Drawing 36]It is a P-P line sectional view of drawing 37 explaining the principal part of the optical deflection equipment in which an 8th embodiment of this invention is shown.
[Drawing 37]It is a top view of drawing 36.
[Drawing 38]It is a Q-Q line sectional view of drawing 39 explaining the principal part of the optical deflection equipment in which a 9th embodiment of this invention is shown.
[Drawing 39]It is a top view of drawing 38.
[Drawing 40]It is a R-R line sectional view of drawing 41 explaining the principal part of the optical deflection equipment in which a 10th embodiment of this invention is shown.
[Drawing 41]It is a top view of drawing 40.
[Drawing 42]It is a S-S line sectional view of drawing 43 explaining the principal part of the optical deflection equipment in which an 11th embodiment of this invention is shown.
[Drawing 43]It is a top view of drawing 42.
[Drawing 44]It is an explanatory view explaining the principal part of the optical deflection equipment in which an 11th embodiment of this invention is shown.
[Drawing 45]It is a T-T line sectional view of drawing 46 explaining the principal part of the optical deflection equipment in which a 12th embodiment of this invention is shown.
[Drawing 46]It is a top view of drawing 45.
[Drawing 47]It is a U-U line sectional view of drawing 48 explaining the principal part of the optical deflection equipment in which a 13th embodiment of this invention is shown.
[Drawing 48]It is a top view of drawing 47.
[Drawing 49]It is an explanatory view explaining the optical deflection equipment in which a 14th embodiment of this invention is shown.
[Drawing 50]It is an explanatory view explaining the optical deflection equipment in which a 15th embodiment of this invention is shown.
[Drawing 51]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 52]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 53]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
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[Drawing 56]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 57]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 58]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 59]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 60]It is an explanatory view explaining the process of other principal parts of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 61]It is an explanatory view explaining the process of other principal parts of the manufacturing method of the optical deflection equipment shown in the embodiment of this invention.
[Drawing 62]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 63]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 64]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
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[Drawing 66]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 67]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 68]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 69]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 70]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 71]It is an explanatory view explaining the process of the principal part of the manufacturing method of the optical deflection equipment shown in other embodiments of this invention.
[Drawing 72]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 73]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical

deflection equipment which shows the embodiment of further others of this invention.
[Drawing 74]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 75]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 76]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 77]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 78]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 79]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 80]It is an explanatory view explaining the process of the principal part of the manufacturing method of optical deflection equipment which shows the embodiment of further others of this invention.
[Drawing 81]It is an explanatory view explaining the image forming device possessing the optical deflection equipment shown in the embodiment of this invention.
[Drawing 82]It is an explanatory view explaining the image projection display device possessing the optical deflection equipment shown in the embodiment of this invention.
[Drawing 83]It is an explanatory view explaining the optical transmission device possessing the optical deflection equipment shown in the embodiment of this invention.
[Drawing 84]It is a top view for explaining the principal part of the optical deflection equipment in which a 16th embodiment of this invention is shown.
[Drawing 85]It is an A-A' line sectional view of drawing 84.
[Drawing 86]It is a top view for explaining the principal part of the optical deflection equipment in which a 17th embodiment of this invention is shown.
[Drawing 87]It is an A-A' line sectional view of drawing 86.
[Drawing 88]It is a top view for explaining the principal part of the optical deflection equipment in which an 18th embodiment of this invention is shown.
[Drawing 89]It is a top view for explaining the principal part of the optical deflection equipment in which a 19th embodiment of this invention is shown.
[Drawing 90]It is an A-A' line sectional view of drawing 89.
[Drawing 91]It is a figure explaining a 20th embodiment of this invention.
[Drawing 92]It is a figure explaining a 21st embodiment of this invention.
[Drawing 93]It is a figure explaining a 22nd embodiment of this invention.
[Drawing 94]It is a figure explaining a 23rd embodiment of this invention.
[Drawing 95]It is a figure showing the modification of the fulcrum member applied to a 23rd embodiment.
[Drawing 96]It is a figure explaining a 24th embodiment of this invention.
[Drawing 97]It is a figure explaining the 25th ********** of this invention.
[Drawing 98]It is a figure explaining the 26th ********** of this invention.
[Drawing 99]It is a sectional view of the D-D' line at the time of a reset action of the optical deflection equipment 2100 in drawing 98.
[Drawing 100]It is a figure explaining a 27th embodiment of this invention.
[Drawing 101]It is a figure explaining a 28th embodiment of this invention.
[Drawing 102]It is a figure explaining a 29th embodiment of this invention.
[Drawing 103]It is a figure explaining the example which applied the optical deflection array 1200 of this invention to the image projection display device.
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[Drawing 105]It is a figure showing the example which applied the optical deflection array 1200 of this invention to the optical transmission device.
[Drawing 106]It is a figure showing the optical deflection equipment 2100 of this invention, or the manufacturing process of the optical deflection array 1200.
[Drawing 107]It is a figure showing the process of forming the convex part of the slant face of the 24th embodiment.
[Drawing 108]It is a figure for explaining the form of a fulcrum member.
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[Drawing 110]It is a figure to the convex part in a 25th embodiment of this invention showing a modification embodiment.
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[Drawing 112]It is a figure showing the embodiment of a regulating member.
[Drawing 113]It is a perspective view for describing the modification embodiment of a regulating member.
[Drawing 114]It is a sectional view of the optical deflection equipment using the regulating member of the modification embodiment.
[Drawing 115]It is a perspective view showing the further modification embodiment of a regulating member.
[Drawing 116]It is a sectional view showing the example of use of the regulating member of a modification embodiment.
[Drawing 117]It is a sectional view showing the example of use of the regulating member of a modification embodiment.
[Drawing 118]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Drawing 119]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Drawing 120]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Drawing 121]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments

of this invention.
[Drawing 122]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Drawing 123]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Drawing 124]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
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[Drawing 127]It is a figure showing the manufacture procedure of the optical deflection equipment concerning other embodiments of this invention.
[Explanations of letters or numerals]
0 Optical deflection equipment
1 Reflective means
1a Reflector
1b Aluminum system metal membrane
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2a Curved shape section
2b Conductive area
2c Silicon nitride film
2 d Contact portion
3 Substrate
3a Hollow form part
3b (100) The silicon substrate which has a plane direction
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$4a_1$ cylindrical shape
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$4b_2$ round shape
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4 d, $4d_1$, $4d_2$, $4d_3$, a $4d_4$ slant face
4e Ridge form part
The shape of $4e_1$ linearity
$4e_2$ round shape
4 f Silicon oxide film
4 g Silicon nitride film
5 Bamboo hat shape member
$5a_{1-n}$ bamboo hat shape member
5b Insulator layer
5c Translucency film
5 d Silicon oxide film
5e Shading film
5 f Chromium oxide film
6 and $6a_1$, $6a_2$, $6a_3$, a $6a_4$ electrode
6b Protective film
7 Sacrifice layer
7a The 1st sacrifice layer
7b The 2nd sacrifice layer
7c The 3rd sacrifice layer
10 One-dimensional optical deflection array
20, 20a, and 20b Two-dimensional optical deflection array
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101 Independent drive means
102 Light source
103 The 1st lens system
104 The 2nd lens system
105 Projection lens
106 Diaphragm
107 Rotary collar hole
108 Microlens array
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201 Picture support
202 Latent image formation means
203 Developing means
204 Transfer means
205 Electrifying means

206 Fixing means
207 Delivery tray
208 Cleaning means
300 Image projection display device
301 Optical switch means
302 Projection screen
400 Optical transmission device
401 Lightwave signal input means
401a, $401a_1$, a $401a_2$ signal input transfer port
402 Optical switch means
402a, a $402a_1$ control device
403 Lightwave signal output means
403a, $403a_1$, a $403a_2$ signal output transfer port
(a_1) Substrate upper fulcrum component formation process
(a_2) Electrode formation process
(a_3) Protection film formation process
(a_4) 1st sacrifice layer formation process
(a_5) A reflective means and plate shape component formation process
(a_6) 2nd sacrifice layer formation process
(a_7) Bamboo hat shape member patternizing process
(a_8) Bamboo hat shape member formation process
(a_9) Sacrifice layer removal process
(b_1) Substrate upper fulcrum component formation process
(b_2) Electrode formation process
(b_3) Protection film formation process
(b_4) 1st sacrifice layer formation process
(b_5) 3rd sacrifice layer formation process
(b_6) A reflective means and plate shape component formation process
(b_7) 2nd sacrifice layer formation process
(b_8) Bamboo hat shape member patternizing process
(b_9) Bamboo hat shape member formation process
(b_{10}) Sacrifice layer removal process
(c_1) A substrate top hollow form part and fulcrum member formation process
(c_2) Electrode formation process
(c_3) Protection film formation process
(c_4) 1st sacrifice layer formation process
(c_5) A reflective means and plate shape component formation process
(c_6) 2nd sacrifice layer formation process
(c_7) Bamboo hat shape member patternizing process
(c_8) Bamboo hat shape member formation process
(c_9) Sacrifice layer removal process
601 Fulcrum member
602 Conductive member
603 An insulating film
701 Convex part
800 Electrode
801 Insulating layer
802 A conductive layer
1200 An optical deflection array
1300 An image projection display device
1301 An optical switch means
1400 An image forming device
1402 A latent image formation means
1500 An optical transmission device
1502 A lightwave signal input part
1503 The 1st step of optical deflection array
1505 The 2nd step of optical deflection array
1507 A lightwave signal outputting part
2100 Optical deflection equipment
2101 A substrate
2102 A regulating member
2103 A fulcrum member
2104 A plate-like member
2201 A dielectric layer
2202 A conductor layer
2301 An electrode

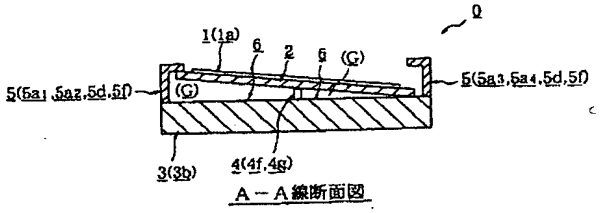
2401 A fulcrum member
2402 A contacted part

[Translation done.]

* NOTICES *

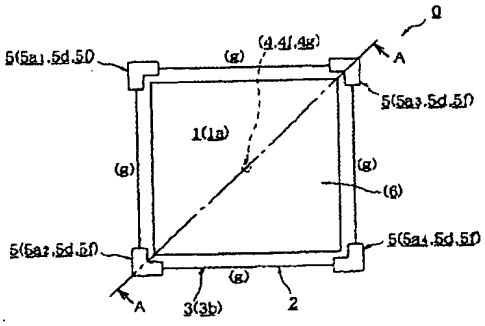
DRAWINGS

[Drawing 1]

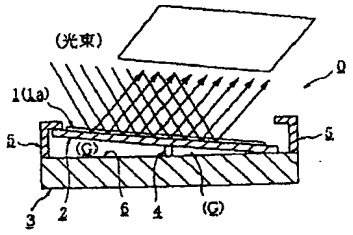


A－A線断面図

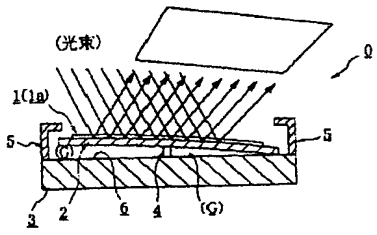
[Drawing 2]



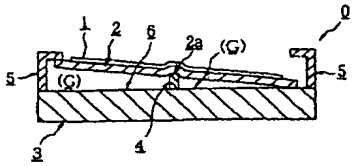
[Drawing 3]



[Drawing 4]

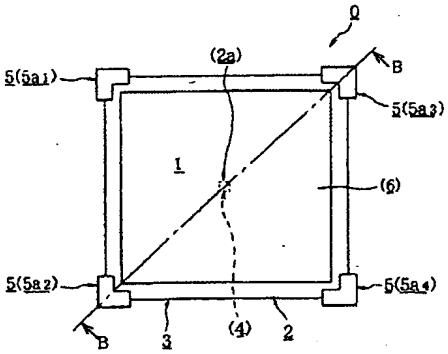


[Drawing 5]

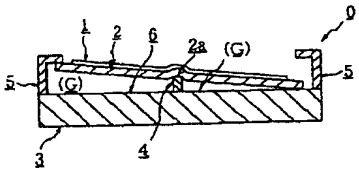


B－B線断面図

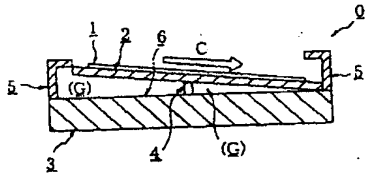
[Drawing 6]



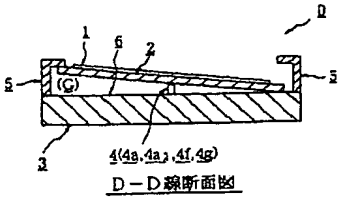
[Drawing 7]



[Drawing 8]

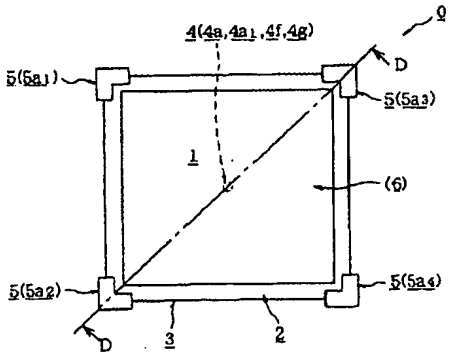


[Drawing 9]

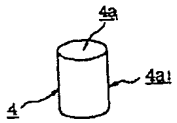


D－D線断面図

[Drawing 10]



[Drawing 11]



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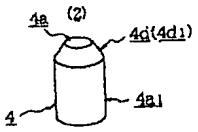
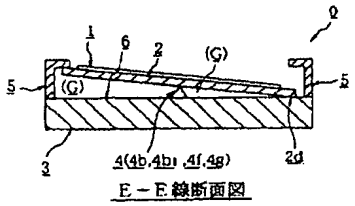
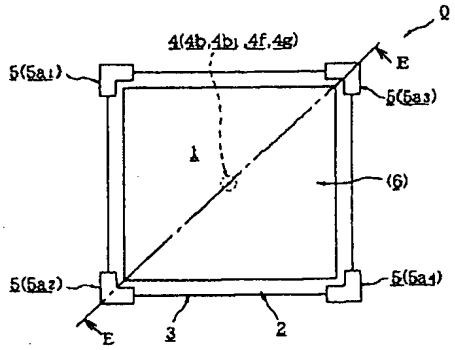


[Drawing 13]

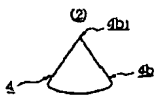


E－E線断面図

[Drawing 14]

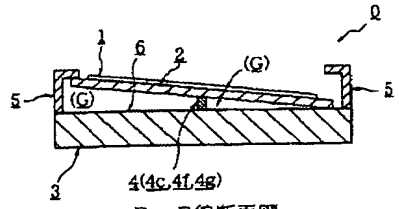


[Drawing 15]



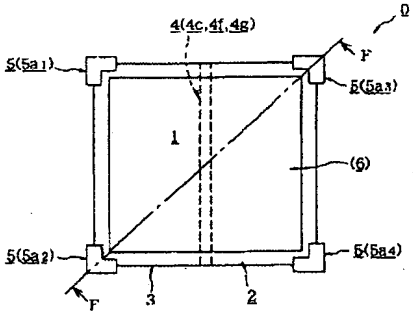
[Drawing 16]

[Drawing 17]

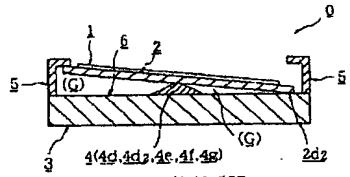


F－F線断面図

[Drawing 18]

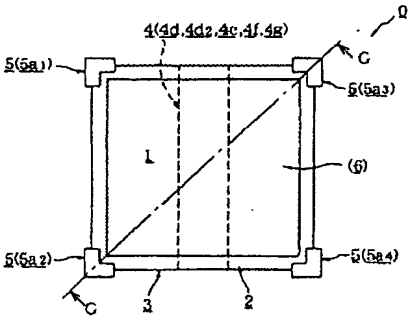


[Drawing 19]



G－G線断面図

[Drawing 20]



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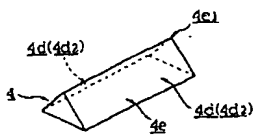
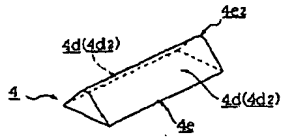
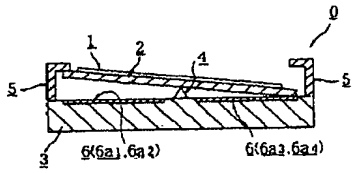


[Drawing 22]

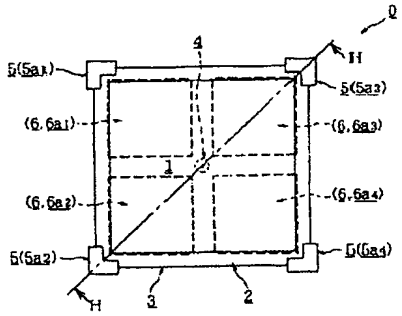


[Drawing 23]

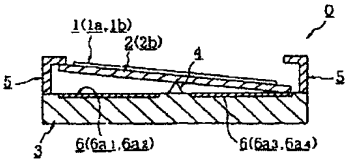


H－H線断面図

[Drawing 24]

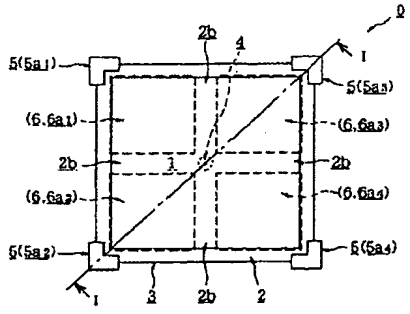


[Drawing 25]

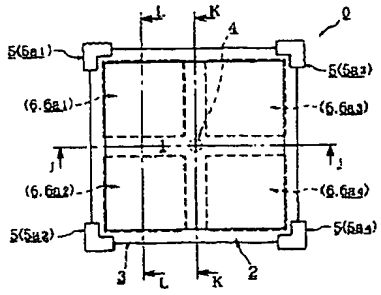


I－I線断面図

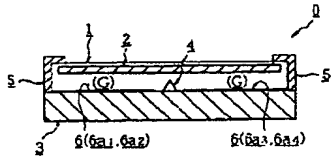
[Drawing 26]



[Drawing 27]

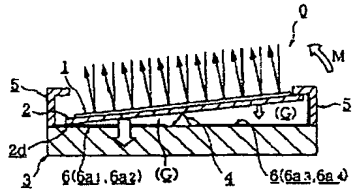


[Drawing 28]



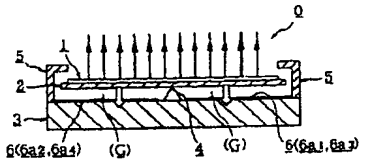
J－J線断面図

[Drawing 29]



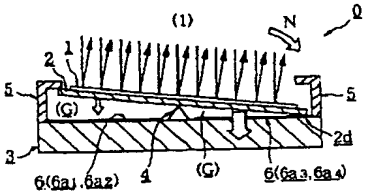
J－J線断面図

[Drawing 30]



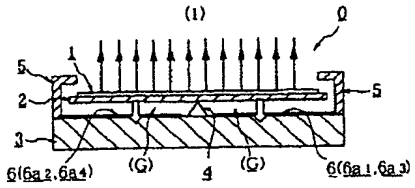
K－K線断面図

[Drawing 31]



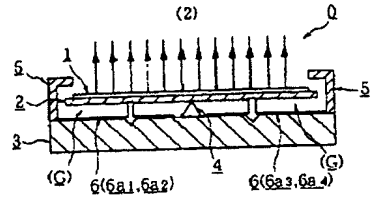
J－J線断面図

[Drawing 32]



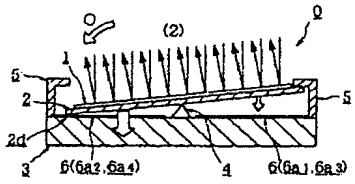
K－K線断面図

[Drawing 33]



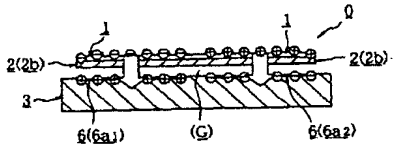
J－J線断面図

[Drawing 34]



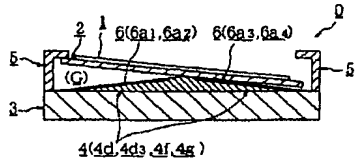
K－K線断面図

[Drawing 35]



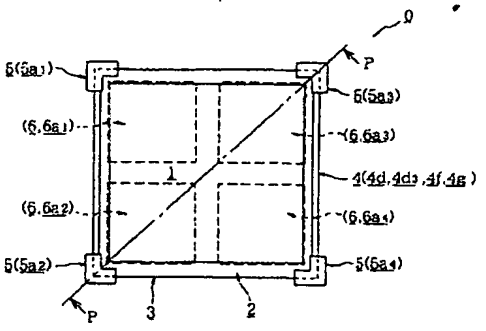
L－L線断面図

[Drawing 36]

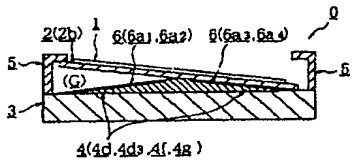


P－P線断面図

[Drawing 37]

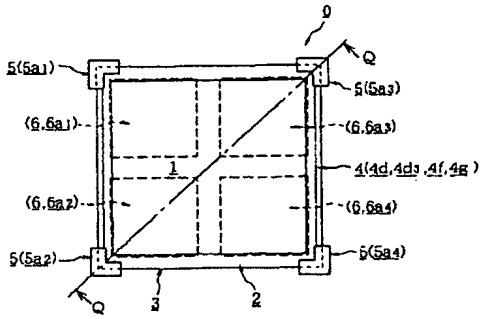


[Drawing 38]

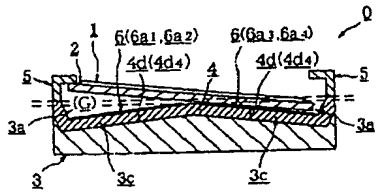


Q－Q線断面図

[Drawing 39]

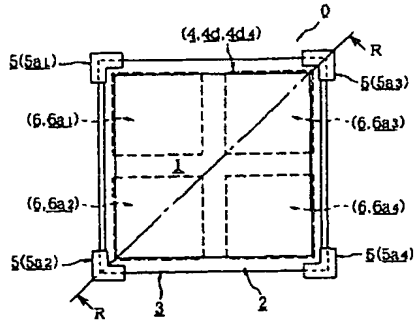


[Drawing 40]

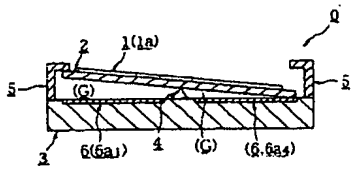


R－R線断面図

[Drawing 41]

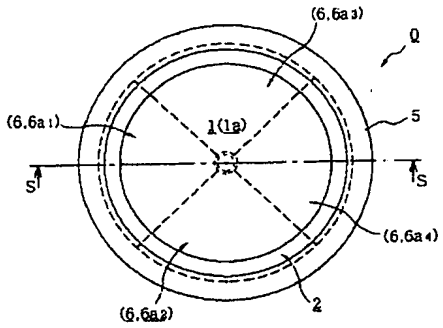


[Drawing 42]

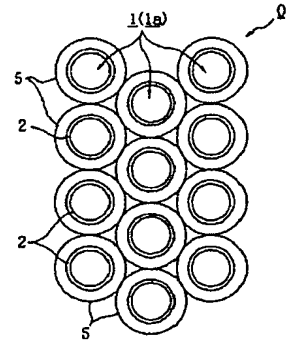


S－S線断面図

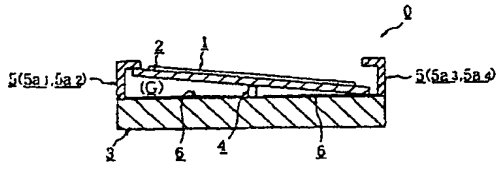
[Drawing 43]



[Drawing 44]

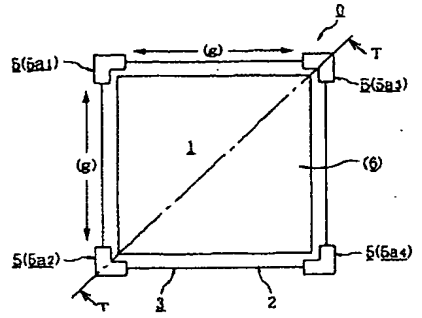


[Drawing 45]

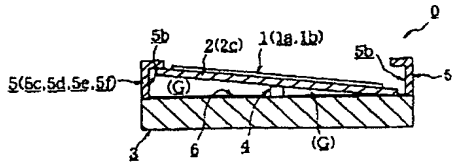


T－T線断面図

[Drawing 46]

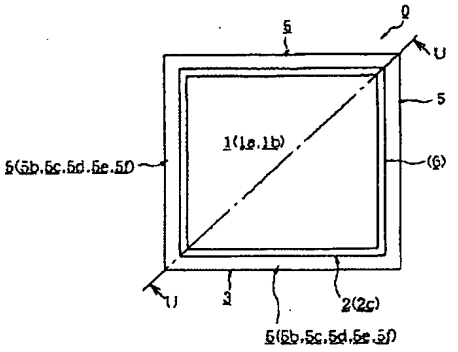


[Drawing 47]

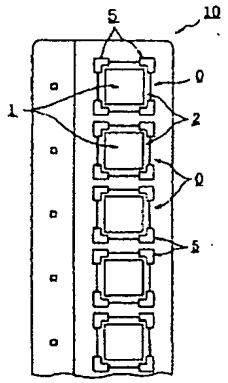


U－U線断面図

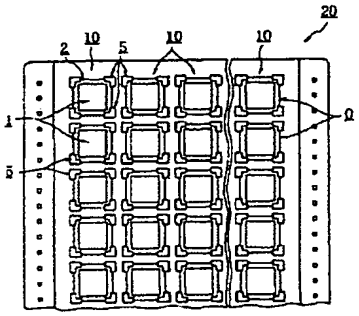
[Drawing 48]



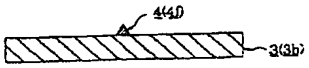
[Drawing 49]



[Drawing 50]

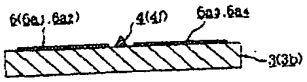


[Drawing 51]



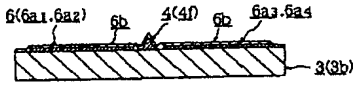
(a1)

[Drawing 52]



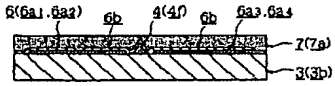
(a2)

[Drawing 53]



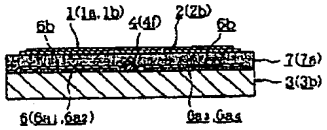
(a3)

[Drawing 54]



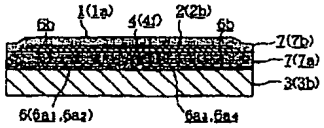
(a4)

[Drawing 55]



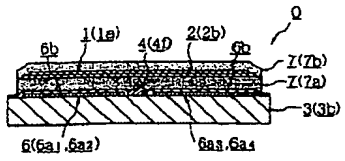
(a5)

[Drawing 56]



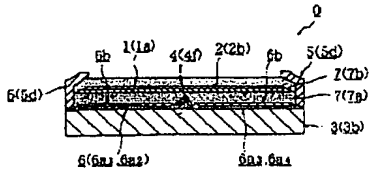
(a6)

[Drawing 57]



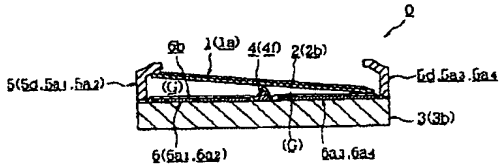
(a 7)

[Drawing 58]



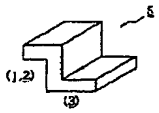
(a 8)

[Drawing 59]

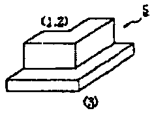


(a 9)

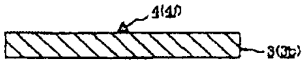
[Drawing 60]



[Drawing 61]

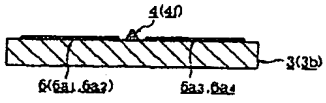


[Drawing 62]



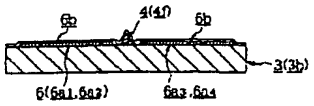
(b 1)

[Drawing 63]



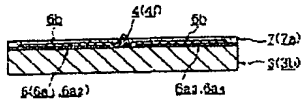
(b 2)

[Drawing 64]



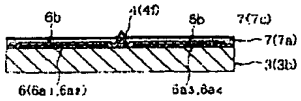
(b3)

[Drawing 65]



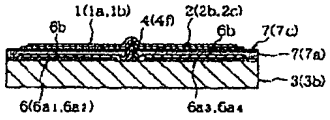
(b4)

[Drawing 66]



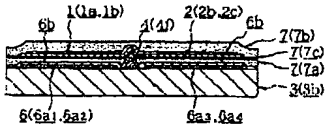
(b5)

[Drawing 67]



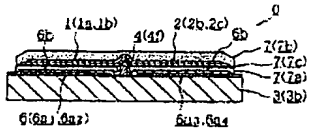
(b6)

[Drawing 68]



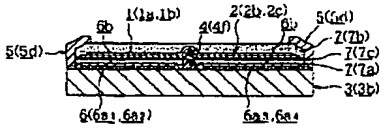
(b7)

[Drawing 69]



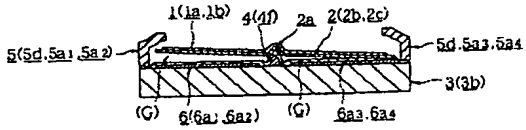
(b8)

[Drawing 70]



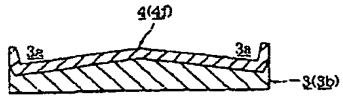
(b9)

[Drawing 71]



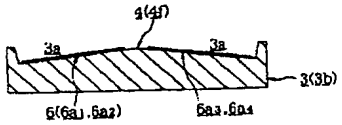
(b10)

[Drawing 72]



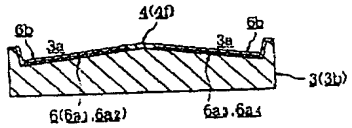
(c1)

[Drawing 73]



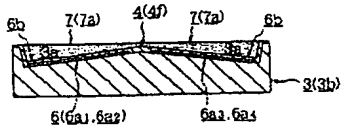
(c2)

[Drawing 74]



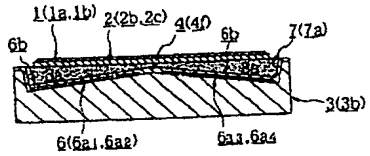
(c3)

[Drawing 75]



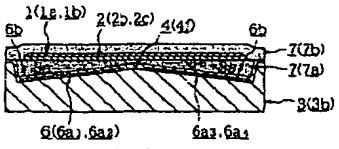
(c4)

[Drawing 76]



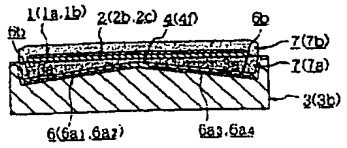
(c5)

[Drawing 77]



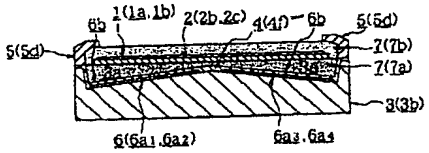
(c6)

[Drawing 78]



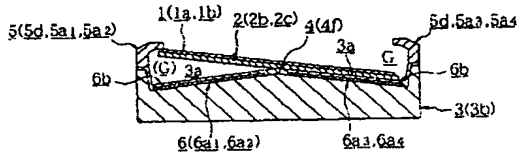
(c 7)

[Drawing 79]



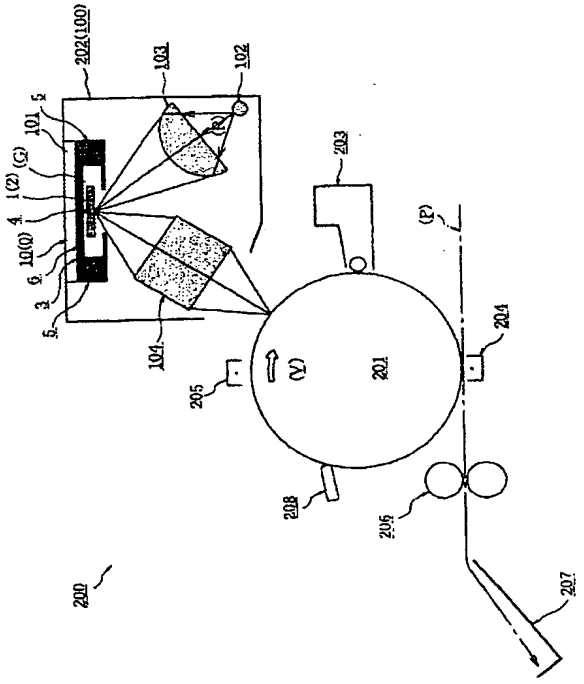
(c 8)

[Drawing 80]

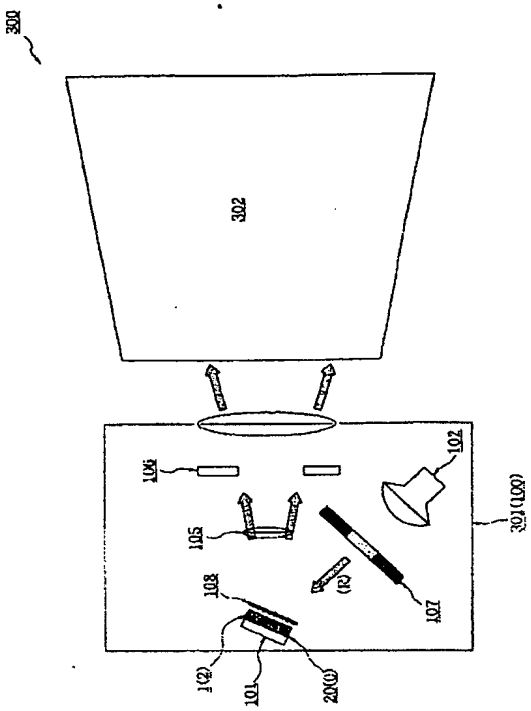


(c 9)

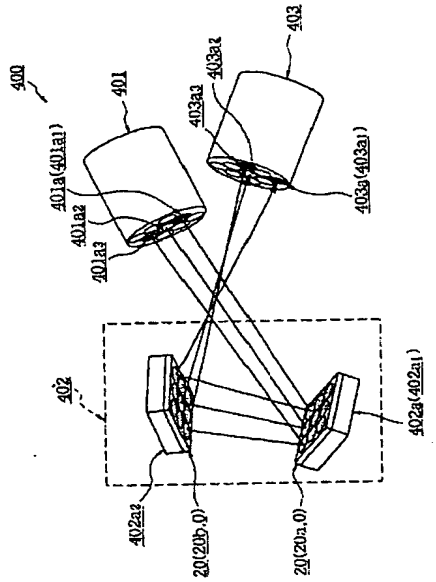
[Drawing 81]



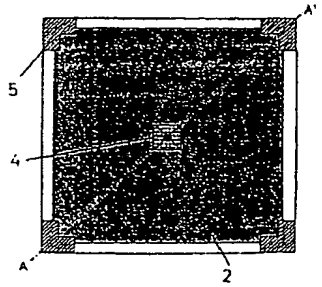
[Drawing 82]



[Drawing 83]



[Drawing 84]



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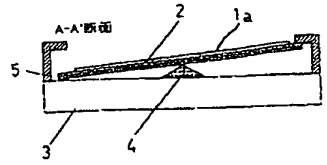

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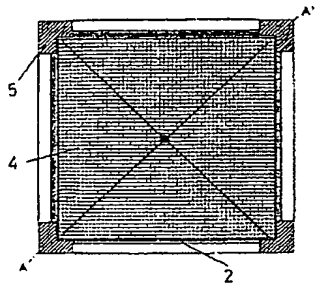
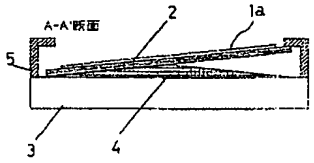
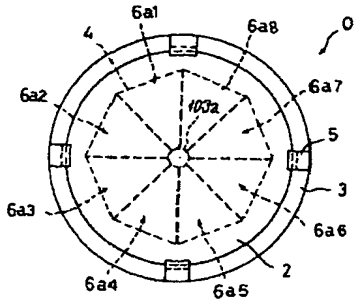


[Drawing 87]



[Drawing 88]



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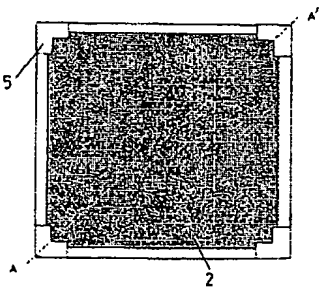
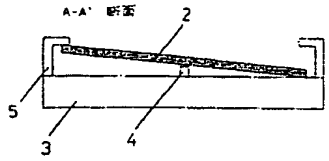
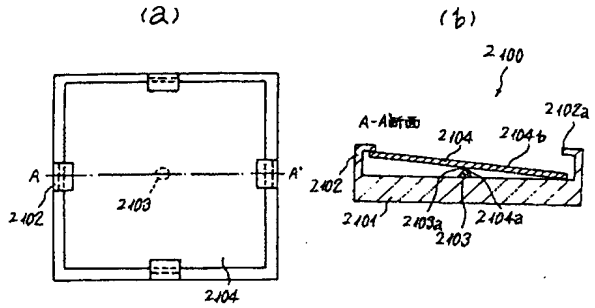


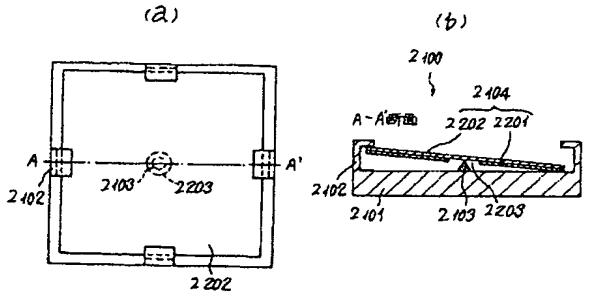
[Drawing 90]



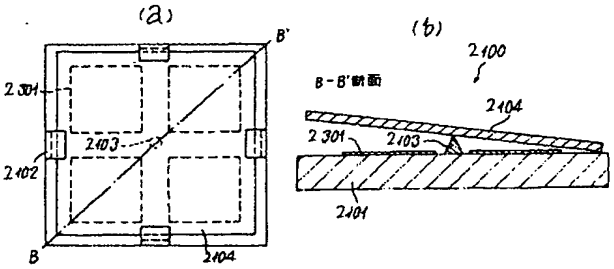
[Drawing 91]



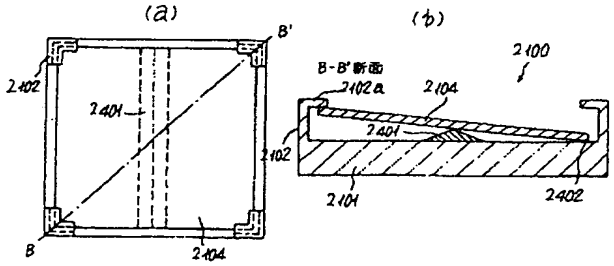
[Drawing 92]



[Drawing 93]



[Drawing 94]



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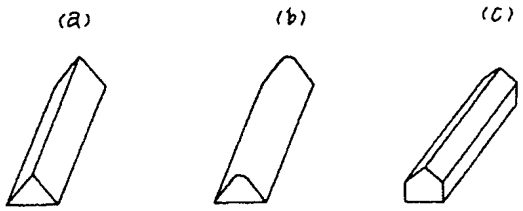
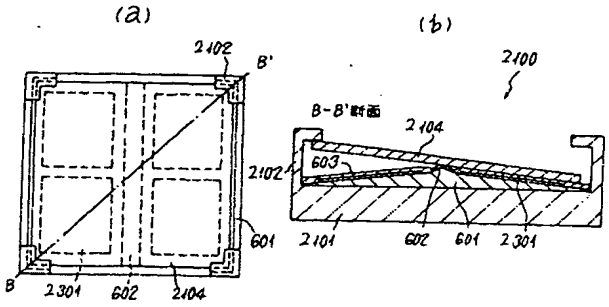
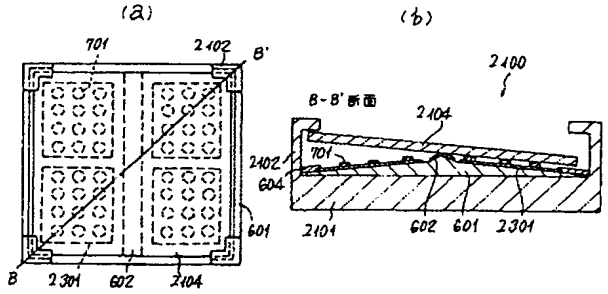


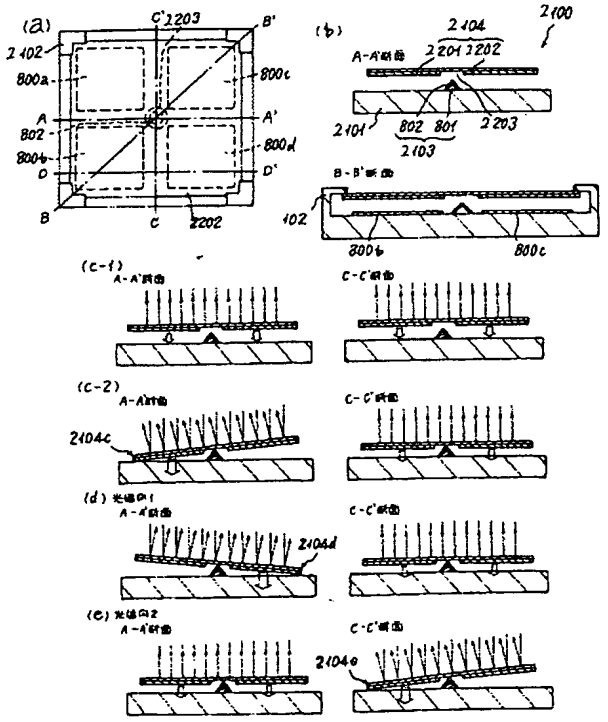
[Drawing 96]



[Drawing 97]



[Drawing 98]



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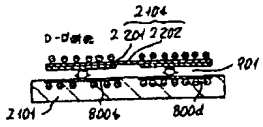

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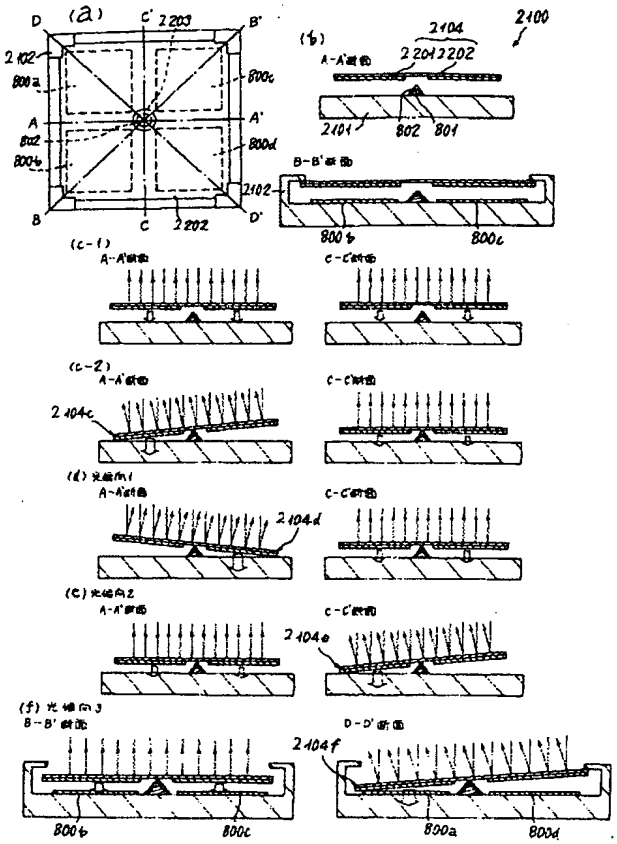

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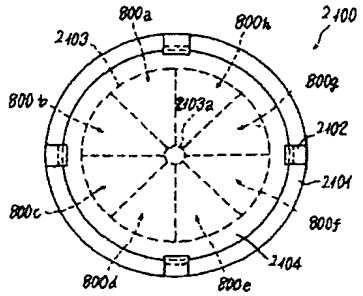

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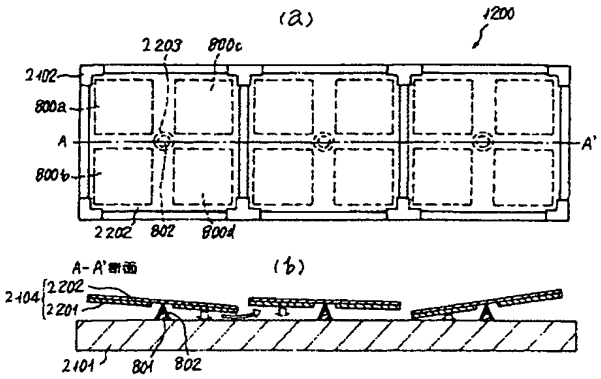

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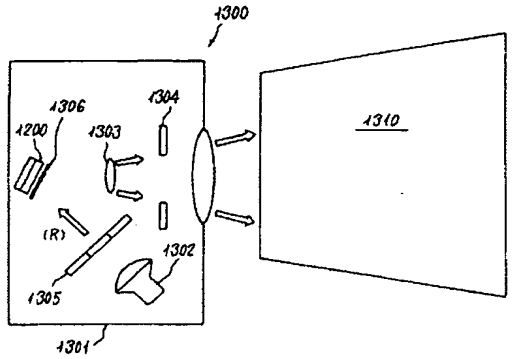

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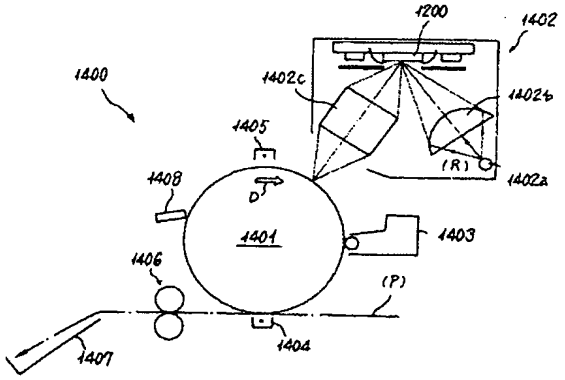

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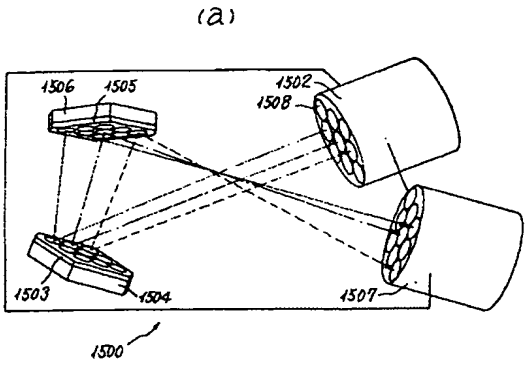

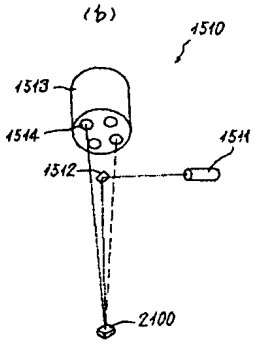

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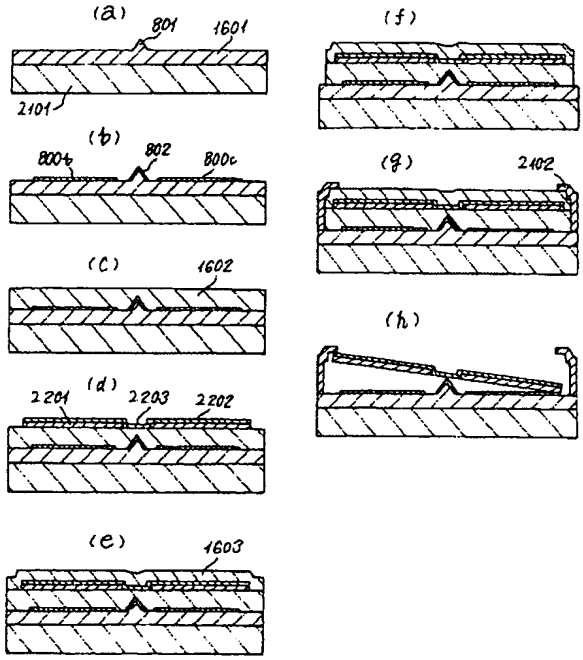
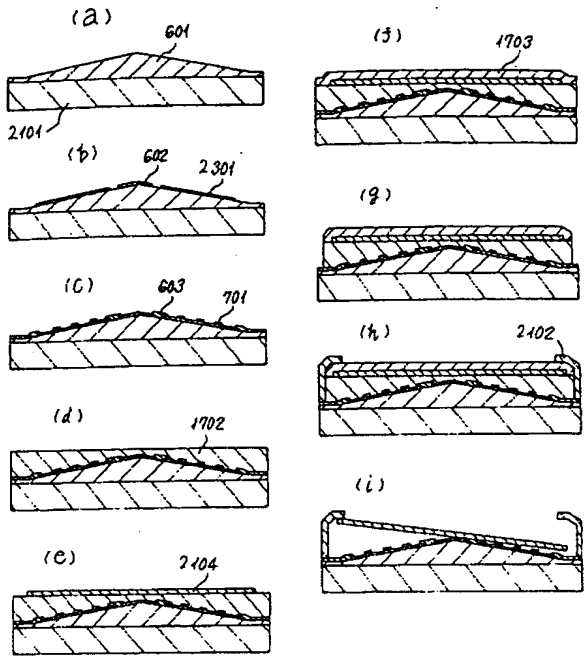
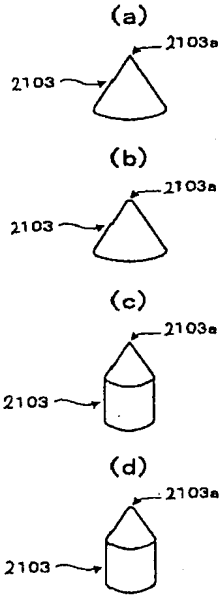


[Drawing 107]



[Drawing 108]



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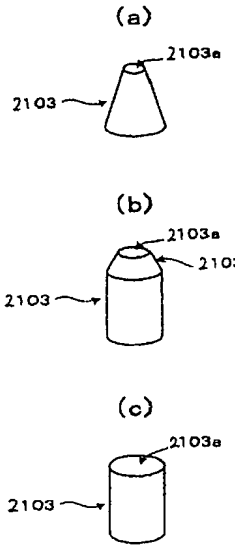
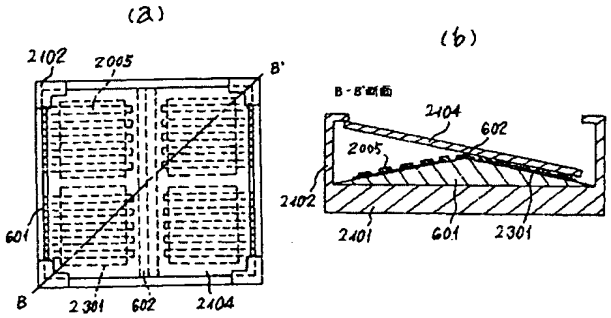
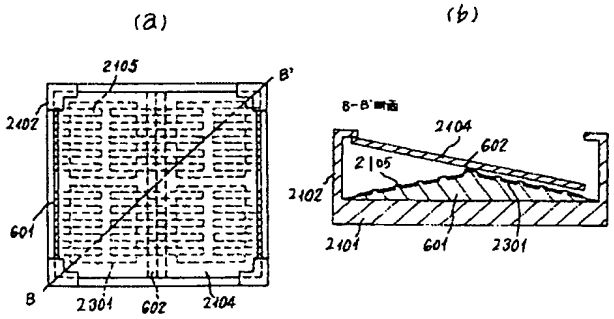


[Drawing 110]



[Drawing 111]



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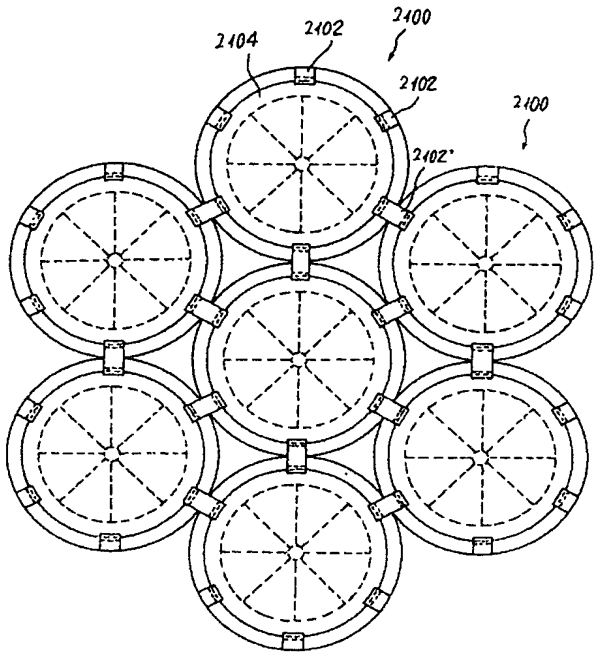
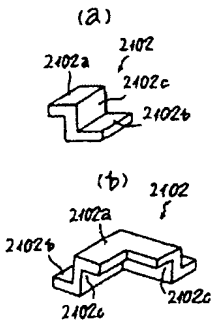
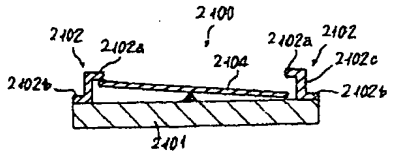


[Drawing 113]



[Drawing 114]



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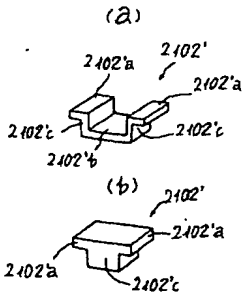
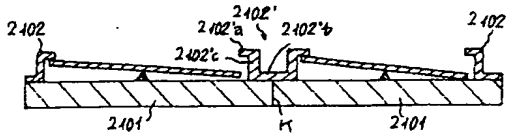
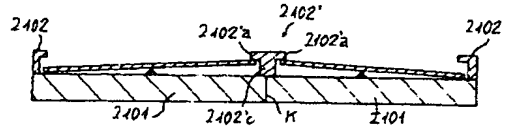


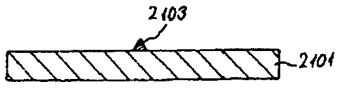
[Drawing 116]



[Drawing 117]



[Drawing 118]



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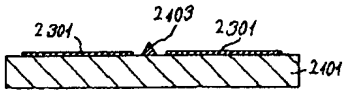
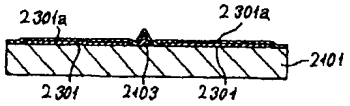


[Drawing 120]



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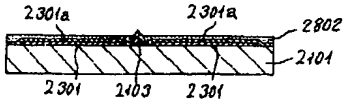

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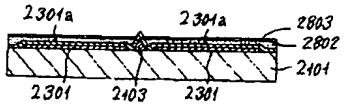
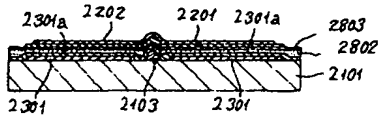


[Drawing 123]



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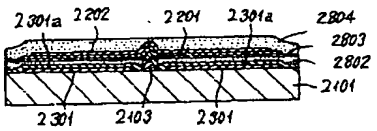
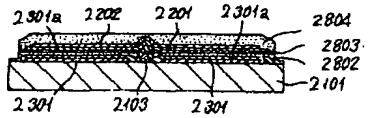
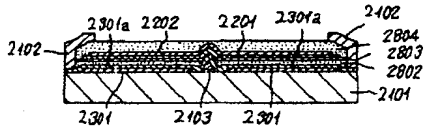


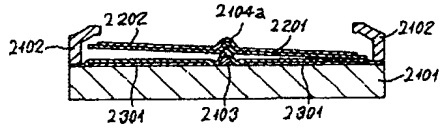
[Drawing 125]



[Drawing 126]



[Drawing 127]



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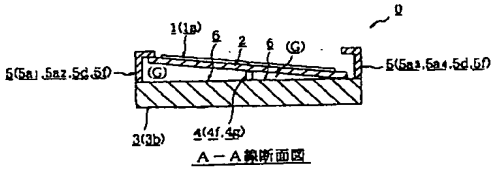
最終頁に続く

(54)【発明の名称】光偏向方法並びに光偏向装置及びその光偏向装置の製造方法並びにその光偏向装置を具備する光情報処理装置及び画像形成装置及び画像投影表示装置及び光伝送装置

(57)【要約】
【課題】１軸又は２軸方向に光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、入射光の波長が制限されることなく、機械的強度の劣化が少なく、駆動電圧が低く、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向方法並びに光偏向装置及びその光偏向装置の製造方法並びにその光偏向装置を具備する光情報処理装置及び画像形成装置及び画像投影表示装置及び光伝送装置を提供する。
【解決手段】板形状部材２を、基板３上に固定することなく基板上の支点部材４上と笠形状部材５間に形成される空隙（Ｇ）内に変位が自由の状態で配置して、基板３上の支点部材４の周囲に板形状部材２と対向して配置した電極６に電位を付与して、支点部材４上に傾斜して載置する板形状部材２上の反射手段１で入射光の反射方向を変えて光偏向を行う。
【選択図】　図１



Ａ－Ａ線断面図

【特許請求の範囲】
【請求項１】
入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う光偏向方法において、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を、基板上に固定することなく上記基板上の支点部材上と笠形状の笠形状部材間に形成される空隙内に変位が自由の状態で配置して、上記基板上の上記支点部材の周囲に上記板形状部材と対向して配置した電極に電位を付与して、上記支点部材上に傾斜して載置する上記板形状部材上の上記反射手段で入射光の反射方向を変えて光偏向を行うことを特徴とする光偏向方法。
【請求項２】
請求項１に記載の光偏向方法において、電極は、基板上の支点部材の周囲に板形状部材と対向して配列した複数個の各電極に異なる電位を付与して光偏向を行うことを特徴とする光偏向方法。
【請求項３】
請求項１又は２に記載の光偏向方法において、電極に異なる電位を付与して、反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を基板上の斜面に接触して、入射光の反射方向を接触する位置で規定して変えて光偏向を行なうことを特徴とする光偏向方法。
【請求項４】
入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う光偏向装置において、入射光を反射する反射手段と、上記反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材と、上記板形状部材を固定することなく載置する基板と、上記基板上の傾斜する上記板形状部材の変位時の支点となる支点部材と、上記支点部材上に上記板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材と、上記基板上の上記支点部材の周囲に上記板形状部材の裏面と対向して配置した電極とからなることを特徴とする光偏向装置。
【請求項５】
請求項４に記載の光偏向装置において、反射手段の反射面は、平板で形成されていることを特徴とする光偏向装置。
【請求項６】
請求項４又は５に記載の光偏向装置において、反射手段は、アルミニウム系金属膜で形成されていることを特徴とする光偏向装置。
【請求項７】
請求項４、５又は６に記載の光偏向装置において、板形状部材は、支点部材と接する個所の面形状に湾曲形状の湾曲形状部からなることを特徴とする光偏向装置。
【請求項８】
請求項４、５、６又は７に記載の光偏向装置において、板形状部材は、外形が円形状であることを特徴とする光偏向装置。
【請求項９】
請求項４、５、６、７又は８に記載の光偏向装置において、板形状部材は、シリコン窒化膜からなることを特徴とする光偏向装置。
【請求項１０】
請求項４、５、６、７、８又は９に記載の光偏向装置において、反射手段又は板形状部材は、導電性を有する導電性領域を有して、上記導電性領域が電極と対向することを特徴とする光偏向装置。
【請求項１１】
請求項４、５、６、７、８、９又は１０に記載の光偏向装置において、基板は、窪み形状の窪み形状部からなることを特徴とする光偏向装置。
【請求項１２】
請求項４、５、６、７、８、９、１０又は１１に記載の光偏向装置において、基板は、（

１００）面方位を有するシリコン基板からなることを特徴とする光偏向装置。
【請求項１３】
請求項４、５、６、７、８、９、１０、１１又は１２に記載の光偏向装置において、支点部材は、板形状部材と接する個所の面形状が円形状部であることを特徴とする光偏向装置。
【請求項１４】
請求項４、５、６、７、８、９、１０、１１又は１２に記載の光偏向装置において、支点部材は、板形状部材と点で接する円錐形状部であることを特徴とする光偏向装置。
【請求項１５】
請求項４、５、６、７、８、９、１０、１１又は１２に記載の光偏向装置において、支点部材は、板形状部材と接する面が長方形の長方形状部であることを特徴とする光偏向装置。
【請求項１６】
請求項４、５、６、７、８、９、１０、１１又は１２に記載の光偏向装置において、支点部材は、板形状部材と線で接する尾根の形状からなる尾根形状部であることを特徴とする光偏向装置。
【請求項１７】
請求項４、５、６、７、８、９、１０、１１又は１２に記載の光偏向装置において、支点部材は、板形状部材と接する斜面を有することを特徴とする光偏向装置。
【請求項１８】
請求項４乃至１７の何れか一項に記載の光偏向装置において、支点部材は、酸化シリコン膜又はシリコン窒化膜からなることを特徴とする光偏向装置。
【請求項１９】
請求項４乃至１８の何れか一項に記載の光偏向装置において、笠形状部材は、板形状部材の外周に対応して複数個の各笠形状部材を所定間隔を空けて配置したことを特徴とする光偏向装置。
【請求項２０】
請求項４乃至１８の何れか一項に記載の光偏向装置において、笠形状部材は、板形状部材の外周に対応する全領域に配置したことを特徴とする光偏向装置。
【請求項２１】
請求項４乃至２０の何れか一項に記載の光偏向装置において、笠形状部材は、絶縁性を有する絶縁膜からなることを特徴とする光偏向装置。
【請求項２２】
請求項４乃至２１の何れか一項に記載の光偏向装置において、笠形状部材は、入射光束に対し透光性を有する透光性膜からなることを特徴とする光偏向装置。
【請求項２３】
請求項４乃至２２の何れか一項に記載の光偏向装置において、笠形状部材は、酸化シリコン膜からなることを特徴とする光偏向装置。
【請求項２４】
請求項４乃至２３の何れか一項に記載の光偏向装置において、笠形状部材は、入射光束に対し遮光性を有する遮光性膜からなることを特徴とする光偏向装置。
【請求項２５】
請求項４乃至２４の何れか一項に記載の光偏向装置において、笠形状部材は、酸化クロム膜からなることを特徴とする光偏向装置。
【請求項２６】
請求項４乃至２５の何れか一項に記載の光偏向装置において、電極は、複数個の各電極からなり、板形状部材は電気的に浮いていることを特徴とする光偏向装置。
【請求項２７】
請求項２６に記載の光偏向装置において、複数個の各電極は、板形状部材の裏面と対向した斜面上に配置したことを特徴とする光偏向装置。

【請求項２８】
請求項４乃至２７の何れか一項に記載の複数個の光偏向装置において、１次元アレー状に配列した１次元光偏向アレーを形成したことを特徴とする光偏向装置。
【請求項２９】
請求項４乃至２８の何れか一項に記載の複数個の光偏向装置においては、２次元アレー状に配列した２次元光偏向アレーを形成したことを特徴とする光偏向装置。
【請求項３０】
入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う請求項４乃至２９の何れか一項に記載の光偏向装置の製造方法において、基板上に支点部材と電極を形成し、堆積して平坦化した第１の犠牲層を介して上記反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を形成して、更に堆積した第２の犠牲層とをパターン化した所定の位置に笠形状部材をパターン化した後に、上記第１の犠牲層と上記第２の犠牲層を除去することを特徴とする光偏向装置の製造方法。
【請求項３１】
請求項３０に記載の光偏向装置の製造方法において、基板上に支点部材と電極を形成し、上記支点部材を突出させて堆積して平坦化した第１の犠牲層に重ねて堆積して平坦化した第３の犠牲層を介して上記反射手段を表面に組み合わせ構成する薄膜で形成された湾曲形状の湾曲形状部からなる板形状部材を形成して、更に堆積した第２の犠牲層とをパターン化した所定の位置に笠形状部材をパターン化した後に、上記第１の犠牲層と上記第２の犠牲層と上記第３の犠牲層を除去することを特徴とする光偏向装置の製造方法。
【請求項３２】
請求項３０に記載の光偏向装置の製造方法において、基板上に窪み形状部と上記窪み形状部内に斜面からなる支点部材と電極を形成し、堆積して平坦化した第１の犠牲層を介して上記反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を形成して、更に堆積した第２の犠牲層とをパターン化した所定の位置に笠形状部材をパターン化した後に、上記第１の犠牲層と第２の犠牲層を除去することを特徴とする光偏向装置の製造方法。
【請求項３３】
請求項３０、３１又は３２に記載の光偏向装置の製造方法において、笠形状部材の複数個の各笠形状部材間を空けて配置した所定間隔から犠牲層を除去することを特徴とする光偏向装置の製造方法。
【請求項３４】
入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う光偏向装置を使用して光情報の処理を行なう光情報処理装置において、複数の上記請求項４乃至２９の何れか一項に記載の光偏向装置と、複数の上記光偏向装置を各々独立に駆動する独立駆動手段とからなることを特徴とする光情報処理装置。
【請求項３５】
電子写真プロセスで光書き込みを行なって画像を形成する画像形成装置において、回動可能に保持されて形成画像を担持する画像担持体と、上記画像担持体上に光書き込みを行なって潜像を形成する上記請求項４乃至２９の何れか一項に記載の光偏向装置からなる潜像形成手段と、上記潜像形成手段の上記光偏向装置によって形成された潜像を顕像化してトナー画像を形成する現像手段と、上記現像手段で形成されたトナー画像を被転写体に転写する転写手段。
【請求項３６】
画像を投影して表示する画像投影表示装置において、画像投影データの入射光の反射方向を変えて光偏向を行なって画像を投影して表示する請求項４乃至２９の何れか一項に記載の光偏向装置からなる光スイッチ手段と、上記光スイッチ手段が投影する画像を表示する投影スクリーンとからなることを特徴とする画像投影表示装置。
【請求項３７】
光信号の光路を決定して出力して伝送する光伝送装置において、光信号を入力する光信号

入力手段と、上記光信号入力手段からの光信号の入射光の反射方向を１軸又は２軸方向に変えて光偏向を行なって、各光信号の光路を決定する請求項４乃至２９の何れか一項に記載の光偏向装置からなる光スイッチ手段と、上記光スイッチ手段からの光信号を出力する光信号出力手段とからなることを特徴とする光伝送装置。

【請求項３８】

請求項３７に記載の光偏向装置において、光スイッチ手段は、複数段の光偏向装置からなることを特徴とする光伝送装置。

【請求項３９】

請求項４ないし１２のいずれか１つに記載の光偏向装置において、前記支点部材は前記板形状部材と点で接触する４角錐形状であることを特徴とする光偏向装置。

【請求項４０】

請求項３９に記載の光偏向装置において、前記４角錐形状の支点部材の底面の大きさは、前記板形状部材の大きさにほぼ等しいことを特徴とする光偏向装置。

【請求項４１】

請求項４ないし１６のいずれか１つに記載の光偏向装置において、前記板形状部材が静電引力により変位したとき、前記基板と点または線で接触することにより、入射光束の反射方向を決定することを特徴とする光偏向装置。

【請求項４２】

入射光の反射方向を複数の軸方向に変えて光偏向を行う光偏向装置において、入射光を反射する反射機能を有する板形状の板形状部材と、上記板形状部材を固定することなく載置する基板と、上記基板上の傾斜する上記板形状部材の変位時の支点となる支点部材と、上記支点部材上に上記板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材と、上記基板上の上記支点部材の周囲に上記板形状部材の裏面と対向して配置した電極とからなることを特徴とする光偏向装置。

【請求項４３】

請求項４２に記載の光偏向装置において、前記板形状部材は単層薄膜で形成されていることを特徴とする光偏向装置。

【請求項４４】

請求項４２または４３に記載の光偏向装置において、反射手段の反射面は、平板で形成されていることを特徴とする光偏向装置。

【請求項４５】

請求項４２ないし４４のいずれか１つに記載の光偏向装置において、反射手段は、アルミニウム系金属膜で形成されていることを特徴とする光偏向装置。

【請求項４６】

請求項４２ないし４５のいずれか１つに記載の光偏向装置において、板形状部材は、支点部材と接する個所の面形状に湾曲形状の湾曲形状部からなることを特徴とする光偏向装置。

【請求項４７】

請求項４２ないし４６のいずれか１つにに記載の光偏向装置において、板形状部材は、外形が円形状であることを特徴とする光偏向装置。

【請求項４８】

請求項４２ないし４７のいずれか１つにに記載の光偏向装置において、反射手段又は板形状部材は、導電性を有する導電性領域を有して、上記導電性領域が電極と対向することを特徴とする光偏向装置。

【請求項４９】

請求項４２ないし４８のいずれか１つにに記載の光偏向装置において、基板は、窪み形状の窪み形状部からなることを特徴とする光偏向装置。

【請求項５０】

請求項４２ないし４９のいずれか１つにに記載の光偏向装置において、基板は、（１００）面方位を有するシリコン基板からなることを特徴とする光偏向装置。

【請求項５１】
請求項４２ないし５０のいずれか１つに記載の光偏向装置において、支点部材は、板形状部材と接する個所の面形状が円形状部であることを特徴とする光偏向装置。
【請求項５２】
請求項４２ないし５０のいずれか１つに記載の光偏向装置において、支点部材は、板形状部材と点で接する円錐形状部であることを特徴とする光偏向装置。
【請求項５３】
請求項４２ないし５０のいずれか１つに記載の光偏向装置において、支点部材は、板形状部材と接する面が長方形の長方形状部であることを特徴とする光偏向装置。
【請求項５４】
請求項４２ないし５０のいずれか１つに記載の光偏向装置において、前記支点部材は前記板状部材と点で接触する４角錐形状であることを特徴とする光偏向装置。
【請求項５５】
請求項５４に記載の光偏向装置において、前記４角錐形状の支点部材の底面の大きさは、前記板状部材の大きさにほぼ等しいことを特徴とする光偏向装置。
【請求項５６】
請求項４２ないし５３のいずれか１つに記載の光偏向装置において、前記板状部材が静電引力により変位したとき、前記基板と点または線で接触することにより、入射光束の反射方向を決定することを特徴とする光偏向装置。
【請求項５７】
請求項４２ないし５６のいずれか１つに記載の光偏向装置において、支点部材は、板形状部材と接する斜面を有することを特徴とする光偏向装置。
【請求項５８】
光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記板状部材の電位を前記支点部材との接触により付与することを特徴とする光偏向装置。
【請求項５９】
請求項５９に記載の光偏向装置において、前記板状部材の上面全域が前記光反射領域であることを特徴とする光偏向装置。
【請求項６０】
請求項５８または５９に記載の光偏向装置において、前記板状部材が誘電性を有する部材からなる誘電体層と、前記導電体層との積層により構成されていることを特徴とする光偏向装置。
【請求項６１】
請求項６０に記載の光偏向装置において、前記誘電体層の比誘電率が３以上であることを特徴とする光偏向装置。
【請求項６２】
請求項６０または６１に記載の光偏向装置において、前記板状部材の前記誘電体層はシリコン窒化膜により構成されることを特徴とする光偏向装置。
【請求項６３】
請求項５８ないし６２のいずれか１つに記載の光偏向装置において、前記板状部材の裏面側に対向する前記基板上に電極が複数形成され、該電極は前記支点部材の前記頂部と電気的に分離されていることを特徴とする光偏向装置。
【請求項６４】

請求項６３に記載の光偏向装置において、前記板状部材の前記導電体層の少なくとも一部が前記電極と対向していることを特徴とする光偏向装置。

【請求項６５】

請求項５８ないし６４のいずれか１つに記載の光偏向装置において、前記板状部材と前記支点部材とがほぼ点で接しており、前記支点部材が、円錐体であることを特徴とする光偏向装置。

【請求項６６】

請求項５８ないし６４のいずれか１つに記載の光偏向装置において、前記板状部材と前記支点部材とがほぼ点で接しており、かつ前記支点部材が、複数の斜面を有する多角錐体であることを特徴とする光偏向装置。

【請求項６７】

請求項５８ないし６４のいずれか１つに記載の光偏向装置において、前記板状部材と前記支点部材とがほぼ線で接しており、かつ前記支点部材が、斜面を有し頂部が前記板状部材と線接触可能な稜を有する柱状体であることを特徴とする光偏向装置。

【請求項６８】

請求項６６または６７に記載の光偏向装置において、前記斜面が前記板状部材のほぼ全域に対応して形成され、前記斜面上に静電引力を作用させるための電極を複数有することを特徴とする光偏向装置。

【請求項６９】

請求項６８に記載の光偏向装置において、前記板状部材が前記斜面からの静電引力により変位し、前記斜面へ接触することにより光偏向方向が規定されることを特徴とする光偏向装置。

【請求項７０】

請求項６８に記載の光偏向装置において、前記斜面上に複数の凸部位が形成されており、前記板状部材が前記斜面からの静電引力により変位し、前記凸部位へ接触することにより光偏向方向が規定されることを特徴とする光偏向装置。

【請求項７１】

請求項６８ないし７０のいずれか１つに記載の光偏向装置において、前記板状部材の近傍の雰囲気がほぼ真空であることを特徴する光偏向装置。

【請求項７２】

請求項６８ないし７０のいずれか１つに記載の光偏向装置において、前記板状部材の近傍の雰囲気が不活性な気体の雰囲気であることを特徴する光偏向装置。

【請求項７３】

請求項６３ないし７２のいずれか１つに記載の光偏向装置において、前記複数の電極に最大電位差が所定値以上になるようにそれぞれ任意の電位を与え、前記頂部に与える電位を、前記複数の電極に与える電位の最大値と最小値のいずれか一方の値と等しくすることを特徴とする光偏向装置。

【請求項７４】

請求項６３ないし７２のいずれか１つに記載の光偏向装置において、前記複数の電極のうち、前記板状部材の変位の軸となる前記頂部を通る直線に関して、同じ側に存在する電極において最大電位差が所定値以上になるようにそれぞれ任意の電位を与え、前記頂部に与える電位を、前記複数の電極に与える電位の最大値と最小値の略中間値とすることを特徴とする光偏向装置。

【請求項７５】

請求項５８ないし７４のいずれか１つに記載の光偏向装置において、前記導電体層はアルミニウム系金属膜であることを特徴とする光偏向装置。

【請求項７６】

請求項７５に記載の光偏向装置において、前記光反射領域は前記導電体層が兼ねることを特徴とする光偏向装置。

【請求項７７】

請求項５８ないし７６のいずれか１つに記載の光偏向装置を複数、任意の基板上に１次元又は２次元アレー状に配置したことを特徴とする光偏向アレー。

【請求項７８】

請求項５８ないし７６のいずれか一つに記載の光偏向装置、または請求項７７に記載の光偏向アレーを、画像データに従って入射光の反射方向を切り替える光スイッチ手段として用い、スクリーン上に前記画像データによる画像を投影することを特徴とする画像投影表示装置。

【請求項７９】

請求項７８に記載の画像投影表示装置において、前記光偏向装置の前記板状部材が中立位置にあるときの光反射面の法線方向が、重力の作用方向とほぼ同方向になるように配置することを特徴とする画像投影表示装置。

【請求項８０】

請求項７７に記載の光偏向アレーを、ライン露光型の潜像形成手段として用いることを特徴とする画像形成装置。

【請求項８１】

請求項８０に記載の画像形成装置において、前記光偏向装置の前記板状部材が中立位置にあるときの光反射面の法線方向が、重力の作用方向とほぼ同方向になるように配置することを特徴とする画像形成装置。

【請求項８２】

請求項５８ないし７６のいずれか１つに記載の光偏向装置を光スイッチ手段として用い、光情報の伝送を、１個の入出力ポートと複数の入出力ポート中の任意のポートとの間で切り替えることを特徴とする光伝送装置。

【請求項８３】

請求項７７に記載の光偏向アレーを光スイッチ手段として用い、光情報の伝送を、一方の入出力部の複数の入出力ポートの中の任意のポートと他方の入出力部の複数の入出力ポート中の任意のポートとの間でそれぞれ切り替えることを特徴とする光伝送装置。

【請求項８４】

請求項８３に記載の光伝送装置において、前記光偏向装置の前記板状部材が中立位置にあるときの光反射面の法線方向が、重力の作用方向とほぼ同方向になるように配置することを特徴とする光伝送装置。

【請求項８５】

任意の基板上に、少なくとも、前記支点部材を形成する工程と、複数の電極及び前記支点部材の導電性を有する部材をパターン化して形成する工程と、第１の犠牲層を堆積及び平坦化する工程と、少なくとも１層からなる前記板状部材をパターン化する工程と、第２の犠牲層を堆積する工程と、第１の犠牲層及び第２の犠牲層をパターン化する工程と、該パターン化された第１及び第２の犠牲層の任意の個所に前記規制部材をパターン化する工程と、該パターン化された第１及び第２の犠牲層をエッチングにより除去する工程と、を有することを特徴とする請求項５８ないし７６のいずれか１つに記載の光偏向装置の製造方法。

【請求項８６】

任意の基板上に複数の区画を、１次元または２次元状に密着させて形成し、各区画毎に、少なくとも、前記支点部材を形成する工程と、複数の電極及び前記支点部材の導電性を有する部材をパターン化して形成する工程と、第１の犠牲層を堆積及び平坦化する工程と、少なくとも１層からなる前記板状部材をパターン化する工程と、第２の犠牲層を堆積する工程と、第１の犠牲層及び第２の犠牲層をパターン化する工程と、該パターン化された第１及び第２の犠牲層の任意の個所に前記規制部材をパターン化する工程と、該パターン化された第１及び第２の犠牲層をエッチングにより除去する工程と、を有することを特徴とする請求項７７に記載の光偏向アレーの製造方法。

【請求項８７】

少なくとも、複数の電極上に薄膜を堆積させる工程と、該薄膜をパターン化し凸部位を形

成する工程を有することを特徴とする請求項１１０に記載の光偏向装置の製造方法。
【請求項８８】
光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記基板上に静電引力を作用させるための複数の電極を有し、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、前記支点部材が円錐体であり、該円錐体の頂部が球状であることを特徴とする光偏向装置。
【請求項８９】
光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記基板上に静電引力を作用させるための複数の電極を有し、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、前記支点部材が、円錐体と、該円錐体底面の下に該底面の径と同径の底面を有する円柱とを合体させた形状であることを特徴とする光偏向装置。
【請求項９０】
光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記基板上に静電引力を作用させるための複数の電極を有し、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、前記支点部材が円錐台形状であることを特徴とする光偏向装置。
【請求項９１】
光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記基板上に静電引力を作用させるための複数の電極を有し、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、前記支点部材が円錐台と、該円錐台底面の下に該底面の径と同径の底面を有する円柱とを合体

させた形状であることを特徴とする光偏向装置。

【請求項９２】

光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記基板上に静電引力を作用させるための複数の電極を有し、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、前記支点部材が円柱であることを特徴とする光偏向装置。

【請求項９３】

光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、かつ前記支点部材が、複数の斜面を有する多角錐体であり、前記斜面が前記板状部材のほぼ全域に対応して形成され、前記斜面上に静電引力を作用させるための電極を複数有し、前記斜面上に複数の凸部位が形成されており、前記板状部材が前記斜面からの静電引力により変位し、前記凸部位へ接触することにより光偏向方向が規定され、前記凸部位は、電極上に複数の帯状に配列されていることを特徴とする光偏向装置。

【請求項９４】

光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、かつ前記支点部材が、複数の斜面を有する多角錐体であり、前記斜面が前記板状部材のほぼ全域に対応して形成され、前記斜面上に静電引力を作用させるための電極を複数有し、前記斜面上に複数の凸部位が形成されており、前記板状部材が前記斜面からの静電引力により変位し、前記凸部位へ接触することにより光偏向方向が規定され、前記凸部位は複数の帯状に配列され、該凸部位の周囲の平坦部に前記電極を形成することを特徴とする光偏向装置。

【請求項９５】

光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定

端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ線で接しており、かつ前記支点部材が、斜面を有し頂部が前記板状部材と線接触可能な稜を有する柱状体であり、前記斜面が前記板状部材のほぼ全域に対応して形成され、前記斜面上に静電引力を作用させるための電極を複数有し、前記斜面上に複数の凸部位が形成されており、前記板状部材が前記斜面からの静電引力により変位し、前記凸部位へ接触することにより光偏向方向が規定され、前記凸部位は、電極上に複数の帯状に配列されていることを特徴とする光偏向装置。

【請求項９６】

光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ線で接しており、かつ前記支点部材が、斜面を有し頂部が前記板状部材と線接触可能な稜を有する柱状体であり、前記斜面が前記板状部材のほぼ全域に対応して形成され、前記斜面上に静電引力を作用させるための電極を複数有し、前記斜面上に複数の凸部位が形成されており、前記板状部材が前記斜面からの静電引力により変位し、前記凸部位へ接触することにより光偏向方向が規定され、前記凸部位は複数の帯状に配列され、該凸部位の周囲の平坦部に前記電極を形成することを特徴とする光偏向装置。

【請求項９７】

請求項８８ないし９６のいずれか１つに記載の光偏向装置において、前記板状部材の上面全域が前記光反射領域であることを特徴とする光偏向装置。

【請求項９８】

請求項８８ないし９７のいずれか１つに記載の光偏向装置において、前記板状部材が誘電性を有する部材からなる誘電体層と、前記導電体層との積層により構成されていることを特徴とする光偏向装置。

【請求項９９】

請求項９８に記載の光偏向装置において、前記誘電体層の比誘電率が３以上であることを特徴とする光偏向装置。

【請求項１００】

請求項９８または９９に記載の光偏向装置において、前記板状部材の前記誘電体層はシリコン窒化膜により構成されることを特徴とする光偏向装置。

【請求項１０１】

請求項８８ないし１００のいずれか１つに記載の光偏向装置において、前記電極は、前記板状部材の裏面側に対向する位置に設けられ、該電極は前記支点部材の前記頂部と電気的に分離されていることを特徴とする光偏向装置。

【請求項１０２】

請求項１０１に記載の光偏向装置において、前記板状部材の前記導電体層の少なくとも一部が前記電極と対向していることを特徴とする光偏向装置。

【請求項１０３】

請求項８８ないし１０２のいずれか１つに記載の光偏向装置において、前記規制部材は頂部のストッパの突出方向とは逆方向に突出した延長基部を下端部に有することを特徴とする光偏向装置。

【請求項１０４】
光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記板状部材の電位を前記支点部材との接触により付与する光偏向装置を複数、任意の基板上に１次元又は２次元アレー状に配置し、前記光偏向装置の前記基板を円形とし、隣接する基板同士の前記規制部材の位置を一致させ、両規制部材を一体化して複合規制部材とすることを特徴とする光偏向アレー。
【請求項１０５】
請求項１０４に記載の光偏向アレーにおいて、前記規制部材もしくは複合規制部材を、前記基板の円周上に等間隔に６個配置し、前記光偏向装置を２次元的に最　密に配列したことを特徴とする光偏向アレー。
【請求項１０６】
請求項１０４または１０５に記載の光偏向アレーにおいて、前記規制部材は頂部のストッパの突出方向とは逆方向に突出した延長基部を下端部に有することを特徴とする光偏向アレー。
【請求項１０７】
請求項１０４ないし１０６のいずれか１つに記載の光偏向アレーにおいて、前記複合規制部材は、隣接する２個の基板の境界線上に、両基板に等分に跨って基板上に横たわる平板状の基部の対向する両端に、直立部を設け、両直立部の頂部に、前記境界線と逆方向に突出するストッパをそれぞれ設けた形であることを特徴とする光偏向アレー。
【請求項１０８】
請求項１０４ないし１０６のいずれか１つに記載の光偏向アレーにおいて、前記複合規制部材は、隣接する２個の基板の境界線上に、両基板に等分に跨って基板上に直立部を設け、該直立部の頂部に、双方向に突出するストッパを有することを特徴とする光偏向アレー。
【請求項１０９】
任意の基板上に、少なくとも、前記支点部材を形成する工程と、複数の電極及び前記支点部材の導電性を有する部材をパターン化して形成する工程と、第１の犠牲層を堆積及び平坦化する工程と、少なくとも１層からなる前記板状部材をパターン化する工程と、第２の犠牲層を堆積する工程と、第１の犠牲層及び第２の犠牲層をパターン化する工程と、該パターン化された第１及び第２の犠牲層の任意の個所に前記規制部材をパターン化する工程と、該パターン化された第１及び第２の犠牲層をエッチングにより除去する工程と、を有することを特徴とする請求項８８ないし１０８のいずれか１つに記載の光偏向装置の製造方法。
【請求項１１０】
請求項１０９に記載の光偏向装置の製造方法において、前記支点部材の頂部は、前記平坦化された第１の犠牲層より突出していることを特徴とする光偏向装置の製造方法。
【請求項１１１】
任意の基板上に複数の区画を、１次元または２次元状に密着させて形成し、各区画毎に、少なくとも、前記支点部材を形成する工程と、複数の電極及び前記支点部材の導電性を有する部材をパターン化して形成する工程と、第１の犠牲層を堆積及び平坦化する工程と、少なくとも１層からなる前記板状部材をパターン化する工程と、第２の犠牲層を堆積する工程と、第１の犠牲層及び第２の犠牲層をパターン化する工程と、該パターン化された第１及び第２の犠牲層の任意の個所に前記規制部材をパターン化する工程と、該パターン化

された第１及び第２の犠牲層をエッチングにより除去する工程と、を有することを特徴とする請求項１０４ないし１０８のいずれか１つに記載の光偏向アレーの製造方法。
【請求項１１２】
請求項１１１に記載の光偏向アレーの製造方法において、前記支点部材の頂部は、前記平坦化された第１の犠牲層より突出していることを特徴とする光偏向アレーの製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、光偏向方法並びに光偏向装置及びその光偏向装置の製造方法並びにその光偏向装置を具備する光情報処理装置及びその光偏向装置を具備する画像形成装置及びその光偏向装置を具備する画像投影表示装置及びその光偏向装置を具備する光伝送装置に関し、詳しくは、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う光偏向方法、並びに、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う光偏向装置及びその光偏向装置の製造方法、並びに、その光偏向装置を具備する光情報の処理を行なう光情報処理装置、及び、その光偏向装置を具備する電子写真プロセスで光書き込みを行なって画像を形成する画像形成装置、及び、その光偏向装置を具備する画像を投影して表示する画像投影表示装置、及び、その光偏向装置を具備する光信号の光路を決定して出力して伝送する光伝送装置に関する。
本発明は入射光に対する出射光の方向を変える光偏向装置の構成に関する。応用分野として、電子写真プロセスにおける光書込デバイス等の画像装置、及びプロジェクターなどの映像装置、及び電気信号伝達に変わる光通信・光接続機器などがある。
【０００２】
【従来の技術】
静電力を利用した光スイッチデバイスの入射光の反射方向を変えて光偏向を行う光偏向装置では、片持ち梁を静電力で　ませて、入射光の反射方向を変えてスイッチするデバイス、及び、それを用いた光偏向システムは、既に公知である。又　、回折格子を静電力で駆動して光スイッチする素子も公知である（例えば　特許文献１、特許文献２、特許文献３、非特許文献１、非特許文献２　参照。）。
更に、デジタルマイクロミラーデバイスと一般的に称される「ＤＭＤ」を一次元、又は、二次元に配置した光偏向システムを用いた画像形成装置も公知である（例えば　特許文献４　参照。）。
更に、デジタルマイクロミラーデバイスと一般的に称される「ＤＭＤ」の素子構造として、ねじり梁型やカンチレバー梁型においては、ミラー部は傾斜されて用いられるが、ミラー部は少なくとも一箇所以上の固定端を有している構造となっている。
然し、片持ち梁を利用した光スイッチやカンチレバー梁型のデジタルマイクロミラーデバイス（例えば　非特許文献３　参照。）と一般的に称されるＤＭＤは、梁の安定性の確保が難しく、応答速度も遅い。非特許文献３に示され該ねじり梁型やカンチレバー型のデジタルマイクロミラーデバイスにおいては、本発明同様ミラー部は傾斜されて用いられるが、本発明の光偏向装置と異なり、ミラー部は少なくとも一箇所以上の固定端を有している構造となっている。
ねじり梁型のデジタルマイクロミラーデバイスと一般的に称されるＤＭＤは、ねじり梁のヒンジ部の機械的強度が長期間使用時に変化して劣化する。回折格子を静電力で駆動して光スイッチする素子は、使用される入射光の波長が制限される。
又、両端固定型の梁を円筒状に　み変形させて、高速に光偏向を行う素子も公知である（例えば　特許文献５　参照。）。然し、平行な空隙を電極間に有し、その静電引力による両端固定梁を円筒上に　ませるために、高速に変形することが可能で応答速度を速くすることは出来るが、両端が固定されているから、駆動電圧が片持ち梁等に比べ高くなっている。
【０００３】
そこで、同一出願人の発明者から、平行、又は、非平行な空隙を介した電極間に作用させ

る静電力により、ミラーが形成される両端固定梁を変形させ空隙を介して対向する基板に接触させ、光反射面に入射する入射光束の反射方向を変えることで光偏向する光偏向装置において、任意の基板上に窪み部を有し、且つ、該窪み部の任意の箇所に少なくとも二つ以上の電極を有し、該電極は互いに異なる電位を与えることが出来、且つ、該窪み部と空隙を介して対向する基板平面上部に光反射領域が設置された梁を有し、且つ、該梁及び該光反射領域が電気的に浮いている状態、即ち、接地されることがなく、且つ、任意の電位に接続されることがない光変調装置が提案されている。

然し、同様に、梁の安定性を確保し、応答速度は速いが、両端固定梁型であるために、駆動電圧が片持ち梁等に比べ高くなっている。

更に、２軸可動ミラー、及び、それを用いた表示装置も公知である（例えば　特許文献６参照。）。上述の２　軸可動ミラー、及び、それを用いた表示装置は、磁性金属で構成されたスリ鉢状のミラー板を、永久磁石が配置されたミラー台に針状のピボットで磁力により固定し、ミラー台に形成した複数の電極に異なる電圧を印加して、ミラー板に静電気による電位差を発生させ、ミラー板を電極方向に近づくようにピボットの針状先端を中心にして回転させる２軸可動ミラーの光走査用ミラーである。然し、上述の２軸可動ミラー、及び、それを用いた表示装置は、実質的に磁力によりミラー板がピボット部にてミラー台に固定させている複雑な構造となっていて、完全なフリー状態のミラー板ではない。

更に、ミラー板が磁性金属により構成され、且つ、ミラー台の下部に永久磁石を設置し、且つ、ミラー台を囲むように磁気ヨークを配置していることにより、デバイスの微細化が困難で、複数個配置して個別に動作を行うアレー化が出来ない欠点を有している。又、磁性材料で構成されているため、装置の設置環境の磁力の影響を受けやすいので、使用環境が制限されることになる。

それに対し、本発明においては、磁性材料を積極的に用いていないので、磁場の影響を受けにくい。

従って、従来の入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う光偏向方法、並びに、光偏向装置、及び、その光偏向装置の製造方法、並びに、その光偏向装置を具備する光情報処理装置、及び、その光偏向装置を具備する画像形成装置、及び、その光偏向装置を具備する画像投影表示装置、及び、その光偏向装置を具備する光伝送装置は、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が複雑で作動が不安定で応答も遅く、使用する入射光の波長が制限され、機械的強度が長期間使用時に変化して劣化し、駆動電圧が高く大きな工ネルギーが必要になり、微細化と集積化が困難でコスト高で、使用環境も制限されると言う不具合が生じていた。

【０００４】

【特許文献１】

特許第２９４１９５２号公報

【特許文献２】

特許第３０１６８７１号公報

【特許文献３】

特表平１０－５１０３７４号公報

【特許文献４】

特開平６－１３８４０３号公報

【特許文献５】

特開２０００－２８４２号公報

【特許文献６】

特開平８－２２０４５５号公報

【非特許文献１】

K. E. Petersen. "APPlied PhysicS LetterS". 1977. Vol. 31. No. 8. PP521～PP523

【非特許文献２】

D. M. Bloom. "OPticS LetterS". Vol. 7. No. 9.

ＰＰ６８８～ＰＰ６９０
【非特許文献３】
Ｌ．Ｊ．Ｈｏｒｎｂｅｃｋ．"Ｐｒｏｃ．ＳＰＩＥ"，１９８９．Ｖｏｌ．１１５０，ＰＰ．８６－１０２
【０００５】
【発明が解決しようとする課題】
そこで本発明の課題は、このような問題点を解決するものである。即ち、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向方法並びに光偏向装置及びその光偏向装置の製造方法並びにその光偏向装置を具備する光情報処理装置及びその光偏向装置を具備する画像形成装置及びその光偏向装置を具備する画像投影表示装置及びその光偏向装置を具備する光伝送装置を提供することを目的とする。
【０００６】
本発明の目的を簡単に述べると、ミラーの偏向角の制御が容易かつ安定で、応答速度が速く、長期的な劣化が少なく、より低電圧で駆動でき、反射光のＯＮ／ＯＦＦ比（画像機器におけるＳ／Ｎ比、映像機器におけるコントラスト比に相当）を向上でき、低コストにて微細化と集積化が可能で、かつ１軸又は２軸方向の光偏向を可能とする光偏向装置及び光偏向アレー、及びそれらを用いた画像形成装置、画像投影表示装置及び光伝送装置、及び光偏向装置の製造方法を提供することにある。
【０００７】
【課題を解決するための手段】
上記目的を達成するために、請求項１の本発明は、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う光偏向方法において、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を、基板上に固定することなく上記基板上の支点部材上と笠形状の笠形状部材間に形成される空隙内に変位が自由の状態で配置して、上記基板上の上記支点部材の周囲に上記板形状部材と対向して配置した電極に電位を付与して、上記支点部材上に傾斜して載置する上記板形状部材上の上記反射手段で入射光の反射方向を変えて光偏向を行う光偏向方法であることを最も主要な特徴とする。
請求項２の本発明は、請求項１に記載の光偏向方法において、電極は、基板上の支点部材の周囲に板形状部材と対向して配列した複数個の各電極に異なる電位を付与して光偏向を行う光偏向方法であることを主要な特徴とする。
請求項３の本発明は、請求項１又は２に記載の光偏向方法において、電極に異なる電位を付与して、反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を基板上の斜面に接触して、入射光の反射方向を接触する位置で規定して変えて光偏向を行なう光偏向方法であることを主要な特徴とする。
【０００８】
請求項４の本発明は、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う光偏向装置において、入射光を反射する反射手段と、上記反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材と、上記板形状部材を固定することなく載置する基板と、上記基板上の傾斜する上記板形状部材の変位時の支点となる支点部材と、上記支点部材上に上記板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材と、上記基板上の上記支点部材の周囲に上記板形状部材の裏面と対向して配置した電極とからなる光偏向装置であることを最も主要な特徴とする。
請求項５の本発明は、請求項４　に記載の光偏向装置において、反射手段の反射面は、平板で形成されている光偏向装置であることを主要な特徴とする。
請求項６の本発明は、請求項４又は５に記載の光偏向装置において、反射手段は、アルミニウム系金属膜で形成されている光偏向装置であることを主要な特徴とする。
請求項７の本発明は、請求項４、５又は６に記載の光偏向装置において、板形状部材は、

支点部材と接する個所の面形状に湾曲形状の湾曲形状部からなる光偏向装置であることを主要な特徴とする。
請求項８の本発明は、請求項４、５、６又は７に記載の光偏向装置において、板形状部材は、外形が円形状である光偏向装置であることを主要な特徴とする。請求項９の本発明は、請求項４、５、６、７又は８に記載の光偏向装置において、板形状部材は、シリコン窒化膜からなる光偏向装置であることを主要な特徴とする。
請求項１０の本発明は、請求項４、５、６、７８　又は9に記載の光偏向装置において、反射手段又は板形状部材は、導電性を有する導電性領域を有して、上記導電性領域が電極と対向する光偏向装置であることを主要な特徴とする。
請求項１１の本発明は、請求項４、５、６、７、８、９又は１０に記載の光偏向装置において、基板は、窪み形状の窪み形状部からなる光偏向装置であることを主要な特徴とする。
【０００９】
請求項１２の本発明は、請求項４、５、６、７、８、９、１０又は１１に記載の光偏向装置において、基板は、（１００　）面方位を有するシリコン基板からなる光偏向装置であることを主要な特徴とする。
請求項１３の本発明は、請求項４、５、６、７、８、９、１０、１１又は１２に記載の光偏向装置において、支点部材は、板形状部材と接する個所の面形状が円形状部である光偏向装置であることを主要な特徴とする。
請求項１４の本発明は、請求項４、５、６、７、８、９、１０、１１又は１２に記載の光偏向装置において、支点部材は、板形状部材と点で接する円錐形状部である光偏向装置であることを主要な特徴とする。
請求項１５の本発明は、請求項４、５、６、７、８、９、１０、１１又は１２に記載の光偏向装置において、支点部材は、板形状部材と接する面が長方形の長方形状部である光偏向装置であることを主要な特徴とする。
請求項１６の本発明は、請求項４、５、６、７、８、９、１０、１１又は１２に記載の光偏向装置において、支点部材は、板形状部材と線で接する尾根の形状からなる尾根形状部である光偏向装置であることを主要な特徴とする。
請求項１７の本発明は、請求項４、５、６、７、８、９、１０、１１又は１２に記載の光偏向装置において、支点部材は、板形状部材と接する斜面を有する光偏向装置であることを主要な特徴とする。
請求項１８の本発明は、請求項４乃至１７の何れか一項に記載の光偏向装置において、支点部材は、酸化シリコン膜又はシリコン窒化膜からなる光偏向装置であることを主要な特徴とする。
請求項１９の本発明は、請求項４乃至１８の何れか一項に記載の光偏向装置において、笠形状部材は、板形状部材の外周に対応して複数個の各笠形状部材を所定間隔を空けて配置した光偏向装置であることを主要な特徴とする。
【００１０】
請求項２０の本発明は、請求項４乃至１８の何れか一項に記載の光偏向装置において、笠形状部材は、板形状部材の外周に対応する全領域に配置した光偏向装置であることを主要な特徴とする。
請求項２１の本発明は、請求項４乃至２０の何れか一項に記載の光偏向装置において、笠形状部材は、絶縁性を有する絶縁膜からなる光偏向装置であることを主要な特徴とする。
請求項２２の本発明は、請求項４乃至２１の何れか一項に記載の光偏向装置において、笠形状部材は、入射光束に対し透光性を有する透光性膜からなる光偏向装置であることを主要な特徴とする。
請求項２３の本発明は、請求項４乃至２２の何れか一項に記載の光偏向装置において、笠形状部材は、酸化シリコン膜からなる光偏向装置であることを主要な特徴とする。
請求項２４の本発明は、請求項４乃至２３の何れか一項に記載の光偏向装置において、笠形状部材は、入射光束に対し遮光性を有する遮光性膜からなる光偏向装置であることを主

要な特徴とする。
請求項２５の本発明は、請求項４乃至２４の何れか一項に記載の光偏向装置において、笠形状部材は、酸化クロム膜からなる光偏向装置であることを主要な特徴とする。
請求項２６の本発明は、請求項４乃至２５の何れか一項に記載の光偏向装置において、電極は、複数個の各電極からなり、板形状部材は電気的に浮いている光偏向装置であることを主要な特徴とする。
請求項２７の本発明は、請求項２６に記載の光偏向装置において、複数個の各電極は、板形状部材の裏面と対向した斜面上に配置した光偏向装置であることを主要な特徴とする。
請求項２８の本発明は、請求項４乃至２７の何れか一項に記載の複数個の光偏向装置において、一次元アレー状に配列した１次元光偏向アレーを形成した光偏向装置であることを主要な特徴とする。
請求項２９の本発明は、請求項４乃至２８の何れか一項に記載の複数個の光偏向装置においては、２次元アレー状に配列した２次元光偏向アレーを形成した光偏向装置であることを主要な特徴とする。
【００１１】
請求項３０の本発明は、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う請求項４乃至２９の何れか一項に記載の光偏向装置の製造方法において、基板上に支点部材と電極を形成し、堆積して平坦化した第１　の犠牲層を介して上記反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を形成して、更に堆積した第２の犠牲層とをパターン化した所定の位置に笠形状部材をパターン化した後に、上記第１の犠牲層と上記第２　の犠牲層を除去する光偏向装置の製造方法であることを最も主要な特徴とする。
請求項３１の本発明は、請求項３０に記載の光偏向装置の製造方法において、基板上に支点部材と電極を形成し、上記支点部材を突出させて堆積して平坦化した第１の犠牲層に重ねて堆積して平坦化した第３の犠牲層を介して上記反射手段を表面に組み合わせ構成する薄膜で形成された湾曲形状の湾曲形状部からなる板形状部材を形成して、更に堆積した第２の犠牲層とをパターン化した所定の位置に笠形状部材をパターン化した後に、上記第１の犠牲層と上記第２の犠牲層と上記第３の犠牲層を除去する光偏向装置の製造方法であることを主要な特徴とする。
請求項３２の本発明は、請求項３０に記載の光偏向装置の製造方法において、基板上に窪み形状部と上記窪み形状部内に斜面からなる支点部材と電極を形成し、堆積して平坦化した第１の犠牲層を介して上記反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を形成して、更に堆積した第２の犠牲層とをパターン化した所定の位置に笠形状部材をパターン化した後に、上記第１の犠牲層と第２の犠牲層を除去する光偏向装置の製造方法であることを主要な特徴とする。
請求項３３の本発明は、請求項３０、３１又は３２に記載の光偏向装置の製造方法において、笠形状部材の複数個の各笠形状部材間を空けて配置した所定間隔から犠牲層を除去する光偏向装置の製造方法であることを主要な特徴とする。
請求項３４の本発明は、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う光偏向装置を使用して光情報の処理を行なう光情報処理装置において、複数の上記請求項４乃至２９の何れか一項に記載の光偏向装置と、複数の上記光偏向装置を各々独立に駆動する独立駆動手段とからなる光情報処理装置であることを最も主要な特徴とする。
【００１２】
請求項３５の本発明は、電子写真プロセスで光書き込みを行なって画像を形成する画像形成装置において、回動可能に保持されて形成画像を担持する画像担持体と、上記画像担持体上に光書き込みを行なって潜像を形成する上記請求項４乃至２９の何れか一項に記載の光偏向装置からなる潜像形成手段と、上記潜像形成手段の上記光偏向装置によって形成された潜像を顕像化してトナー画像を形成する現像手段と、上記現像手段で形成されたトナー画像を被転写体に転写する転写手段とからなる画像形成装置であることを最も主要な特徴とする。

請求項３６の本発明は、画像を投影して表示する画像投影表示装置において、画像投影データの入射光の反射方向を変えて光偏向を行なって画像を投影して表示する請求項４乃至２９の何れか一項に記載の光偏向装置からなる光スイッチ手段と、上記光スイッチ手段が投影する画像を表示する投影スクリーンとからなる画像投影表示装置であることを最も主要な特徴とする。

請求項３７の本発明は、光信号の光路を決定して出力して伝送する光伝送装置において、光信号を入力する光信号入力手段と、上記光信号入力手段からの光信号の入射光の反射方向を１軸又は２軸方向に変えて光偏向を行なって、各光信号の光路を決定する請求項４乃至２９の何れか一項に記載の光偏向装置からなる光スイッチ手段と、上記光スイッチ手段からの光信号を出力する光信号出力手段とからなる光伝送装置であることを最も主要な特徴とする。

請求項３８の本発明は、請求項３７に記載の光偏向装置において、光スイッチ手段は、複数段の光偏向装置からなる光伝送装置であることを主要な特徴とする。

【００１３】

請求項３９に記載の発明では、請求項４ないし１２のいずれか１つに記載の光偏向装置において、前記支点部材は前記板形状部材と点で接触する４角錐形状であることを特徴とする。

請求項４０に記載の発明では、請求項３９に記載の光偏向装置において、前記４角錐形状の支点部材の底面の大きさは、前記板形状部材の大きさにほぼ等しいことを特徴とする。

請求項４１に記載の発明では、請求項４ないし１６のいずれか１つに記載の光偏向装置において、前記板形状部材が静電引力により変位したとき、前記基板と点または線で接触することにより、入射光束の反射方向を決定することを特徴とする。

【００１４】

請求項４２に記載の発明では、入射光の反射方向を複数の軸方向に変えて光偏向を行う光偏向装置において、入射光を反射する反射機能を有する板形状の板形状部材と、上記板形状部材を固定することなく載置する基板と、上記基板上の傾斜する上記板形状部材の変位時の支点となる支点部材と、上記支点部材上に上記板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材と、上記基板上の上記支点部材の周囲に上記板形状部材の裏面と対向して配置した電極とからなることを特徴とする。

請求項４３に記載の発明では、請求項４２に記載の光偏向装置において、前記板形状部材は単層薄膜で形成されていることを特徴とする。

【００１５】

請求項４４に記載の発明では、請求項４２または４３に記載の光偏向装置において、反射手段の反射面は、平板で形成されていることを特徴とする。

請求項４５に記載の発明では、請求項４２ないし４４のいずれか１つに記載の光偏向装置において、反射手段は、アルミニウム系金属膜で形成されていることを特徴とする。

請求項４６に記載の発明では、請求項４２ないし４５のいずれか１つに記載の光偏向装置において、板形状部材は、支点部材と接する個所の面形状に湾曲形状の湾曲形状部からなることを特徴とする。

【００１６】

請求項４７に記載の発明では、請求項４２ないし４６のいずれか１つにに記載の光偏向装置において、板形状部材は、外形が円形状であることを特徴とする。請求項４８に記載の発明では、請求項４２ないし４７のいずれか１つにに記載の光偏向装置において、反射手段又は板形状部材は、導電性を有する導電性領域を有して、上記導電性領域が電極と対向することを特徴とする。

請求項４９に記載の発明では、請求項４２ないし４８のいずれか１つにに記載の光偏向装置において、基板は、窪み形状の窪み形状部からなることを特徴とする。

【００１７】

請求項５０に記載の発明では、請求項４２ないし４９のいずれか１つにに記載の光偏向装置において、基板は、（１００）面方位を有するシリコン基板からなることを特徴とする

請求項５１に記載の発明では、請求項４２ないし５０のいずれか１つにに記載の光偏向装置において、支点部材は、板形状部材と接する個所の面形状が円形状部であることを特徴とする。
請求項５２に記載の発明では、請求項４２ないし５０のいずれか１つにに記載の光偏向装置において、支点部材は、板形状部材と点で接する円錐形状部であることを特徴とする。
【００１８】
請求項５３に記載の発明では、請求項４２ないし５０のいずれか１つにに記載の光偏向装置において、支点部材は、板形状部材と接する面が長方形の長方形状部であることを特徴とする。
請求項５４に記載の発明では、請求項４２ないし５０のいずれか１つに記載の光偏向装置において、前記支点部材は前記板状部材と点で接触する４角錐形状であることを特徴とする。
請求項５５に記載の発明では、請求項５４に記載の光偏向装置において、前記４角錐形状の支点部材の底面の大きさは、前記板状部材の大きさにほぼ等しいことを特徴とする。
【００１９】
請求項５６に記載の発明では、請求項４２ないし５３のいずれか１つに記載の光偏向装置において、前記板状部材が静電引力により変位したとき、前記基板と点または線で接触することにより、入射光束の反射方向を決定することを特徴とする。
請求項５７に記載の発明では、請求項４２ないし５６のいずれか１つにに記載の光偏向装置において、支点部材は、板形状部材と接する斜面を有することを特徴とする。
【００２０】
請求項５８に記載の発明では、光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記板状部材の電位を前記支点部材との接触により付与することを特徴とする。
【００２１】
請求項５９に記載の発明では、請求項５８に記載の光偏向装置において、前記板状部材の上面全域が前記光反射領域であることを特徴とする。
請求項６０に記載の発明では、請求項５８または５９に記載の光偏向装置において、前記板状部材が誘電性を有する部材からなる誘電体層と、前記導電体層との積層により構成されていることを特徴とする。
【００２２】
請求項６１に記載の発明では、請求項６０に記載の光偏向装置において、前記誘電体層の比誘電率が３以上であることを特徴とする。
請求項６２に記載の発明では、請求項６０または６１に記載の光偏向装置において、前記板状部材の前記誘電体層はシリコン窒化膜により構成されることを特徴とする。
【００２３】
請求項６３に記載の発明では、請求項５８ないし６２のいずれか１つに記載の光偏向装置において、前記板状部材の裏面側に対向する前記基板上に電極が複数形成され、該電極は前記支点部材の前記頂部と電気的に分離されていることを特徴とする。
請求項６４に記載の発明では、請求項６３に記載の光偏向装置において、前記板状部材の前記導電体層の少なくとも一部が前記電極と対向していることを特徴とする。
【００２４】

請求項６５に記載の発明では、請求項５８ないし６４のいずれか１つに記載の光偏向装置において、前記板状部材と前記支点部材とがほぼ点で接しており、前記支点部材が、円錐体であることを特徴とする。
請求項６６に記載の発明では請求項５８ないし６４のいずれか１つに記載の光偏向装置において、前記板状部材と前記支点部材とがほぼ点で接しており、かつ前記支点部材が、複数の斜面を有する多角錐体であることを特徴とする。
【００２５】
請求項６７に記載の発明では、請求項５８ないし６４のいずれか１つに記載の光偏向装置において、前記板状部材と前記支点部材とがほぼ線で接しており、かつ前記支点部材が、斜面を有し頂部が前記板状部材と線接触可能な稜を有する柱状体であることを特徴とする。
請求項６８に記載の発明では、請求項６６または６７に記載の光偏向装置において、前記斜面が前記板状部材のほぼ全域に対応して形成され、前記斜面上に静電引力を作用させるための電極を複数有することを特徴とする。
【００２６】
請求項６９に記載の発明では、請求項６８に記載の光偏向装置において、前記板状部材が前記斜面からの静電引力により変位し、前記斜面へ接触することにより光偏向方向が規定されることを特徴とする。
請求項７０に記載の発明では、請求項６８に記載の光偏向装置において、前記斜面上に複数の凸部位が形成されており、かつ前記板状部材が前記斜面からの静電引力により変位し、前記凸部位へ接触することにより光偏向方向が規定されることを特徴とする。
【００２７】
請求項７１に記載の発明では、請求項５８ないし７０のいずれか１つに記載の光偏向装置において、前記板状部材の近傍の雰囲気がほぼ真空であることを特徴とする。
請求項７２に記載の発明では、請求項５８ないし７０のいずれか１つに記載の光偏向装置において、前記板状部材の近傍の雰囲気が不活性な気体の雰囲気であることを特徴とする。
【００２８】
請求項７３に記載の発明では、請求項６３ないし７２のいずれか１つに記載の光偏向装置において、前記複数の電極に最大電位差が所定値以上になるようにそれぞれ任意の電位を与え、前記頂部に与える電位を、前記複数の電極に与える電位の最大値と最小値のいずれか一方の値と等しくすることを特徴とする。
請求項７４に記載の発明では、請求項６３ないし７２のいずれか１つに記載の光偏向装置において、前記複数の電極のうち、前記板状部材の変位の軸となる前記頂部を通る直線に関して、同じ側に存在する電極において最大電位差が所定値以上になるようにそれぞれ任意の電位を与え、前記頂部に与える電位を、前記複数の電極に与える電位の最大値と最小値の略中間値とすることを特徴とする。
【００２９】
請求項７５に記載の発明では、請求項５８ないし７４のいずれか１つに記載の光偏向装置において、前記導電体層はアルミニウム系金属膜であることを特徴とする。
請求項７６に記載の発明では、請求項７５に記載の光偏向装置において、前記光反射領域は前記導電体層が兼ねることを特徴とする。
請求項７７に記載の発明では、請求項５８ないし７６のいずれか１つに記載の光偏向装置を複数、任意の基板上に１次元又は２次元アレー状に配置したことを特徴とする。
【００３０】
請求項７８に記載の発明では、画像投影表示装置において、請求項５８ないし７６のいずれか一つに記載の光偏向装置、または請求項７７に記載の光偏向アレーを、画像データに従って入射光の反射方向を切り替える光スイッチ手段として用い、スクリーン上に前記画像データによる画像を投影することを特徴とする。請求項７９に記載の発明では、請求項７８に記載の画像投影表示装置において、前記光偏向装置の前記板状部材が中立位置にあ

るときの光反射面の法線方向が、重力の作用方向とほぼ同方向になるように配置することを特徴とする。

【００３１】

請求項８０に記載の発明では、画像形成装置において、請求項７７に記載の光偏向アレーを、ライン露光型の潜像形成手段として用いることを特徴とする。

請求項８１に記載の発明では、請求項８０に記載の画像形成装置において、前記光偏向装置の前記板状部材が中立位置にあるときの光反射面の法線方向が、重力の作用方向とほぼ同方向になるように配置することを特徴とする。

【００３２】

請求項８２に記載の発明では、光伝送装置において、請求項６８ないし７６のいずれか１つに記載の光偏向装置を光スイッチ手段として用い、光情報の伝送を、１個の入出力ポートと複数の入出力ポート中の任意のポートとの間で切り替えることを特徴とする。

請求項８３に記載の発明では、光伝送装置において、請求項７７に記載の光偏向アレーを光スイッチ手段として用い、、光情報の伝送を、一方の入出力部の複数の入出力ポートの中の任意のポートと他方の入出力部の複数の入出力ポート中の任意のポートとの間でそれぞれ切り替えることを特徴とする。

請求項８４に記載の発明では、請求項８３に記載の光伝送装置において、前記光偏向装置の前記板状部材が中立位置にあるときの光反射面の法線方向が、重力の作用方向とほぼ同方向になるように配置することを特徴とする。

【００３３】

請求項８５に記載の発明では、請求項５８ないし７６のいずれか１つに記載の光偏向装置の製造方法において、任意の基板上に、少なくとも、前記支点部材を形成する工程と、複数の電極及び前記支点部材の導電性を有する部材をパターン化して形成する工程と、第１の犠牲層を堆積及び平坦化する工程と、少なくとも１層からなる前記板状部材をパターン化する工程と、第２の犠牲層を堆積する工程と、第１の犠牲層及び第２の犠牲層をパターン化する工程と、該パターン化された第１及び第２の犠牲層の任意の個所に前記規制部材をパターン化する工程と、該パターン化された第１及び第２の犠牲層をエッチングにより除去する工程と、を有することを特徴とする。

【００３４】

請求項８６に記載の発明では、請求項７７に記載の光偏向アレーの製造方法において、任意の基板上に複数の区画を、１次元または２次元状に密着させて形成し、各区画毎に、少なくとも、前記支点部材を形成する工程と、複数の電極及び前記支点部材の導電性を有する部材をパターン化して形成する工程と、第１の犠牲層を堆積及び平坦化する工程と、少なくとも１層からなる前記板状部材をパターン化する工程と、第２の犠牲層を堆積する工程と、第１の犠牲層及び第２の犠牲層をパターン化する工程と、該パターン化された第１及び第２の犠牲層の任意の個所に前記規制部材をパターン化する工程と、該パターン化された第１及び第２の犠牲層をエッチングにより除去する工程と、を有することを特徴とする。

【００３５】

請求項８７に記載の発明では、請求項７０に記載の光偏向装置の製造方法において、少なくとも、複数の電極上に薄膜を堆積させる工程と、該薄膜をパターン化し凸部位を形成する工程を有することを特徴とする。

【００３６】

請求項８８に記載の発明では、光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接

触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記基板上に静電引力を作用させるための複数の電極を有し、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、前記支点部材が円錐体であり、該円錐体の頂部が球状であることを特徴とする。

【００３７】

請求項８９に記載の発明では、光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記基板上に静電引力を作用させるための複数の電極を有し、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、前記支点部材が、円錐体と、該円錐体底面の下に該底面の径と同径の底面を有する円柱とを合体させた形状であることを特徴とする。

【００３８】

請求項９０に記載の発明では、光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記基板上に静電引力を作用させるための複数の電極を有し、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、前記支点部材が円錐台形状であることを特徴とする。

【００３９】

請求項９１に記載の発明では、光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記基板上に静電引力を作用させるための複数の電極を有し、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、前記支点部材が円錐台と、該円錐台底面の下に該底面の径と同径の底面を有する円柱とを合体させた形状であることを特徴とする。

【００４０】

請求項９２に記載の発明では、光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一

部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記基板上に静電引力を作用させるための複数の電極を有し、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、前記支点部材が円柱であることを特徴とする。

【００４１】

請求項９３に記載の発明では、光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、かつ前記支点部材が、複数の斜面を有する多角錐体であり、前記斜面が前記板状部材のほぼ全域に対応して形成され、前記斜面上に静電引力を作用させるための電極を複数有し、前記斜面上に複数の凸部位が形成されており、前記板状部材が前記斜面からの静電引力により変位し、前記凸部位へ接触することにより光偏向方向が規定され、前記凸部位は、電極上に複数の帯状に配列されていることを特徴とする。

【００４２】

請求項９４に記載の発明では、光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ点で接しており、かつ前記支点部材が、複数の斜面を有する多角錐体であり、前記斜面が前記板状部材のほぼ全域に対応して形成され、前記斜面上に静電引力を作用させるための電極を複数有し、前記斜面上に複数の凸部位が形成されており、前記板状部材が前記斜面からの静電引力により変位し、前記凸部位へ接触することにより光偏向方向が規定され、前記凸部位は複数の帯状に配列され、該凸部位の周囲の平坦部に前記電極を形成することを特徴とする。

【００４３】

請求項９５に記載の発明では、光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ線で接しており、かつ前記支点部材が、斜面を有し頂部が前記板状部材と線接触可能な稜を有する柱状体であり、前記斜面が前記板状部材のほぼ全域に対応して形成され、前記斜面上に静電引力を作用させるための電極を複数有し、

前記斜面上に複数の凸部位が形成されており、前記板状部材が前記斜面からの静電引力により変位し、前記凸部位へ接触することにより光偏向方向が規定され、前記凸部位は、電極上に複数の帯状に配列されていることを特徴とする。

【００４４】

請求項９６に記載の発明では、光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記板状部材の電位は前記支点部材との接触により付与され、前記板状部材と前記支点部材とがほぼ線で接しており、かつ前記支点部材が、斜面を有し頂部が前記板状部材と線接触可能な稜を有する柱状体であり、前記斜面が前記板状部材のほぼ全域に対応して形成され、前記斜面上に静電引力を作用させるための電極を複数有し、前記斜面上に複数の凸部位が形成されており、前記板状部材が前記斜面からの静電引力により変位し、前記凸部位へ接触することにより光偏向方向が規定され、前記凸部位は複数の帯状に配列され、該凸部位の周囲の平坦部に前記電極を形成することを特徴とする。

【００４５】

請求項９７に記載の発明では、請求項８８ないし９６のいずれか１つに記載の光偏向装置において、前記板状部材の上面全域が前記光反射領域であることを特徴とする。

【００４６】

請求項９８に記載の発明では、請求項８８ないし９７のいずれか１つに記載の光偏向装置において、前記板状部材が誘電性を有する部材からなる誘電体層と、前記導電体層との積層により構成されていることを特徴とする。

【００４７】

請求項９９に記載の発明では、請求項９８に記載の光偏向装置において、前記誘電体層の比誘電率が３以上であることを特徴とする。

【００４８】

請求項１００に記載の発明では、請求項９８または９９に記載の光偏向装置において、前記板状部材の前記誘電体層はシリコン窒化膜により構成されることを特徴とする。

【００４９】

請求項１０１に記載の発明では、請求項８８ないし１００のいずれか１つに記載の光偏向装置において、前記電極は、前記板状部材の裏面側に対向する位置に設けられ、該電極は前記支点部材の前記頂部と電気的に分離されていることを特徴とする。

【００５０】

請求項１０２に記載の発明では、請求項１０１に記載の光偏向装置において、前記板状部材の前記導電体層の少なくとも一部が前記電極と対向していることを特徴とする。

【００５１】

請求項１０３に記載の発明では、請求項８８ないし１０２のいずれか１つに記載の光偏向装置において、前記規制部材は頂部のストッパの突出方向とは逆方向に突出した延長基部を下端部に有することを特徴とする。

【００５２】

請求項１０４に記載の発明では、光反射領域を有する部材に与えられる電位に応じた静電引力により変位することにより、該光反射領域に入射する光束が反射方向を変えて偏向される光偏向装置において、基板と、複数の規制部材と、支点部材と、板状部材とを有し、前記複数の規制部材はそれぞれ上部にストッパを有し、前記基板の複数の端部にそれぞれ設けられ、前記支点部材は導電性を有する部材で構成される頂部を有し、前記基板の上面に設けられ、前記板状部材は固定端を持たず、上面に前記光反射領域を有し、少なくとも

一部に導電性を有する部材からなる導電体層を有し、裏面の少なくとも前記頂部と接する接触点が導電性を有する部材からなり、前記基板と前記支点部材と前記ストッパの間の空間内で可動的に配置され、前記板状部材の電位を前記支点部材との接触により付与する光偏向装置を複数、任意の基板上に１次元又は２次元アレー状に配置し、前記光偏向装置の前記基板を円形とし、隣接する基板同士の前記規制部材の位置を一致させ、両規制部材を一体化して複合規制部材とすることを特徴とする。

【００５３】

請求項１０５に記載の発明では、請求項１０４に記載の光偏向アレーにおいて、前記規制部材もしくは複合規制部材を、前記基板の円周上に等間隔に６個配置し、前記光偏向装置を２次元的に最　密に配列したことを特徴とする。

【００５４】

請求項１０６に記載の発明では、請求項１０４または１０５に記載の光偏向アレーにおいて、前記規制部材は頂部のストッパの突出方向とは逆方向に突出した延長基部を下端部に有することを特徴とする。

【００５５】

請求項１０７に記載の発明では、請求項１０４ないし１０６のいずれか１つに記載の光偏向アレーにおいて、前記複合規制部材は、隣接する２個の基板の境界線上に、両基板に等分に跨って基板上に横たわる平板状の基部の対向する両端に、直立部を設け、両直立部の頂部に、前記境界線と逆方向に突出するストッパをそれぞれ設けた形であることを特徴とする。

【００５６】

請求項１０８に記載の発明では、請求項１０４ないし１０６のいずれか１つに記載の光偏向アレーにおいて、前記複合規制部材は、隣接する２個の基板の境界線上に、両基板に等分に跨って基板上に直立部を設け、該直立部の頂部に、双方向に突出するストッパを有することを特徴とする。

【００５７】

請求項１０９に記載の発明では、任意の基板上に、少なくとも、前記支点部材を形成する工程と、複数の電極及び前記支点部材の導電性を有する部材をパターン化して形成する工程と、第１の犠牲層を堆積及び平坦化する工程と、少なくとも１層からなる前記板状部材をパターン化する工程と、第２の犠牲層を堆積する工程と、第１の犠牲層及び第２の犠牲層をパターン化する工程と、該パターン化された第１及び第２の犠牲層の任意の個所に前記規制部材をパターン化する工程と、該パターン化された第１及び第２の犠牲層をエッチングにより除去する工程と、を有する請求項１２８ないし１４３のいずれか１つに記載の光偏向装置の製造方法を特徴とする。

【００５８】

請求項１１０に記載の発明では、請求項１０９に記載の光偏向装置の製造方法において、前記支点部材の頂部は、前記平坦化された第１の犠牲層より突出していることを特徴とする。

【００５９】

請求項１１１に記載の発明では、任意の基板上に複数の区画を、１次元または２次元状に密着させて形成し、各区画毎に、少なくとも、前記支点部材を形成する工程と、複数の電極及び前記支点部材の導電性を有する部材をパターン化して形成する工程と、第１の犠牲層を堆積及び平坦化する工程と、少なくとも１層からなる前記板状部材をパターン化する工程と、第２の犠牲層を堆積する工程と、第１の犠牲層及び第２の犠牲層をパターン化する工程と、該パターン化された第１及び第２の犠牲層の任意の個所に前記規制部材をパターン化する工程と、該パターン化された第１及び第２の犠牲層をエッチングにより除去する工程と、を有する請求項１４４ないし１４８のいずれか１つに記載の光偏向アレーの製造方法を特徴とする。

【００６０】

請求項１１２に記載の発明では、請求項１１１に記載の光偏向アレーの製造方法において

、前記支点部材の頂部は、前記平坦化された第１の犠牲層より突出していることを特徴とする。

【００６１】

【発明の実施の形態】

次に、本発明の実施の形態を図面を参照して詳細に説明する。

図１及び図２は本発明の第１の実施形態に係る光偏向装置の断面図、及び平面図であり、入射光の反射方向を１軸、又は、２軸方向に変えて光偏向を行う光偏向装置０は、入射光を反射する反射面を備えた反射手段１と、反射手段１を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材２と、板形状部材２を固定することなく載置する基板３の（１００）面方位を有するシリコン基板３ｂと、基板３の上記（１００）面方位を有するシリコン基板３ｂ上の傾斜する板形状部材２の変位時の支点となる支点部材４と、支点部材４上に板形状部材２を変位が自由の状態で配置される空隙（Ｇ）を形成する笠形状の笠形状部材５と、基板３の上記（１００）面方位を有するシリコン基板３ｂ上の支点部材４の周囲に板形状部材２の裏面と対向して配置した電極６とからなり、反射手段１と板形状部材２を、基板３の上記（１００）面方位を有するシリコン基板３ｂ上に固定することなく基板３の上記（１００）面方位を有するシリコン基板３ｂ上の支点部材４上と笠形状部材５間に形成される空隙（Ｇ）内に変位が自由の状態で配置して、基板３の上記（１００）面方位を有するシリコン基板３ｂ上の支点部材４の周囲に板形状部材２と対向して配置した電極６に電位を付与して、支点部材４上に傾斜して載置する板形状部材２上の反射手段１で入射光の反射方向を変えて光偏向を行うようにしたので、入射光の反射方向を１軸、又は、２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で歩留も高く低コストで、使用環境も制限されない。

【００６２】

反射手段１を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材２は、後述するように、薄膜で形成されているので、重量が低減されて、待機時に板形状部材２が笠形状部材５に衝突した場合の衝撃や、動作時に板形状部材２が基板３に接触した場合の衝撃が低減されて、機械的強度が長期間使用時にも変化と劣化が少ない光偏向装置０を提供することが出来るようになっている。

基板３は、微細化のことを考慮するとシリコン、及び、ガラス等の、一般に半導体プロセスや液晶プロセスにて用いられているものが望ましい。

更に、光偏向装置０における基板３は、駆動系回路と同一基板に形成して簡単な構成と低コスト化を考慮して、上記（１００）面方位を有するシリコン基板３ｂで形成されている。

笠形状部材５は、板形状部材２の変位する可動範囲を任意の空隙（Ｇ）に制限するように、笠形状で、板形状部材２の外周に対応して複数個の各笠形状部材５α_1、笠形状部材５α_2、笠形状部材５α_3、笠形状部材５α_4を所定の間隔（ｇ）を空けて４隅に配置されている。又は、図示しないが、笠形状部材５は、板形状部材２の外周に対応する全領域に配置される。

笠形状部材５は、酸化シリコン膜５ｄ、又は、酸化クロム膜５ｆにより形成されている。

従って、光偏向装置０を、図示しない１次元光偏向アレー１０、又は、２次元光偏向アレー２０のようにアレー化した時に、反射手段１の反射面１αの反射領域の面積割合を最大にするために極力薄膜、及び、省スペースで構成でき、且つ、機械的強度が強くなっている。

支点部材４は、板形状部材２が変位する時の支点となり、後述するように、光偏向装置０に求められる性能に応じて任意の形状が選択される。支点部材４は、酸化シリコン膜４ｆ、又は、シリコン窒化膜４ｇで形成されているから機械的強度が強くなっている。但し、支点部材４を通して、板形状部材２の電位を取る場合は、各種金属膜等の導電性材料で形成される。

【００６３】
図３と図４は構成及び動作説明図であり、同図において、板形状部材２の表面に組み合わせ構成された反射手段１の少なくとも光反射領域の反射面１αは、平板で形成されている。図３に、反射手段１の上記反射面１αが、平板である場合の光反射の模式図を、図４に、反射手段１の上記反射面１αが、図示のように凸形状である場合の光反射の模式図を示す。
図３に示すように、反射手段１の上記反射面１αが、平板であることにより、光反射領域に入射した光束は反射方向を揃えて反射することが可能で、反射光を拡散することなく目的の反射方向にのみ光変更が可能となり、光偏向装置０を、図示しない各光情報処理装置１００、画像形成装置２００、画像投影表示装置３００、及び、光伝送装置４００等に用いる場合にも、隣接素子への影響を抑制され、重要である。尚、反射手段１の上記反射面１αの平面性としては、曲率半径Rαが数ｍ以上であることが望まれる。
他方、図４に示すように、仮に、反射手段１の上記反射面１αが、図示のように凸形状を示していた場合、光反射領域に入射した光束は、反射方向を拡散して反射してしまうため、隣接素子への影響が顕著となる。このことは、特に、図示しない上記画像形成装置２００や上記画像投影表示装置３００等において、反射光を、更に、拡大光学系にて光書込み、及び、表示させる場合等に顕著となる。図５乃至図８は本発明の第２の実施形態の断面図、平面図、動作説明図、及び湾曲形状部がない場合の欠点を示す図であり、各図において、板形状部材２は、支点部材４と接する個所の面形状に湾曲形状の湾曲形状部２αが形成されている（図５と図６を参照）。上記湾曲形状部２αを形成する方法は、後述する。
上記湾曲形状部２αは、これを支点部材４の近傍の板形状部材２に配置することにより、静電引力により板形状部材２が傾斜変位する時に、板形状部材２の変位時に上記湾曲形状部２αを中心とした変位が可能となり、板形状部材２がずれることを抑制することが出来る。言い換えると、支点部材４に対する板形状部材２の位置決めが自発的に容易となる。それにより、図７に示すように、板形状部材２の変位時に、板形状部材２が笠形状部材５の側面に接触することを抑制する。
他方、図８に示すように、仮に、上記湾曲形状部２αが無い場合には、板形状部材２が、図示の矢印Ｃ方向の位置にずれる等の不具合が発生し、それによる反射性能は低下し、支点部材４とその部位の機械的磨耗の発生が顕著となり機械的強度が低下する。
【００６４】
図９乃至図１２は本発明の第３の実施形態の断面図、平面図、及び支点部材の構成例を示す斜視図であり、各図において、支点部材４は、板形状部材２と接する個所の面形状が円形状部４αである円柱形状４α１であり、上述のように、上記酸化シリコン膜４ｆ、又は、上記シリコン窒化膜４ｇで形成されているから機械的強度が強くなっている。同様に、支点部材４を通して、板形状部材２の電位を取る場合は、各種金属膜等の導電性材料で形成される。
図１１に示すように、支点部材４は、上記円柱形状４α１である。
然し、図１２に示すように、板形状部材２に近い個所において斜面４αの斜面４α１を有し、上記円形状部４αの接触面積を極力低下させる形状でも良い。
従って、支点部材４は、板形状部材２と接触する領域において、上記円形状部４αを有することから、静電引力に作用する方向に対応した任意の方向へ、反射手段１を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材２を傾斜変位させることが容易に可能となり、板形状部材２と支点部材４の接触面積を低下させて２軸方向の光偏向が容易となる。
図１３乃至図１６は本発明の第４の実施形態の断面図、平面図、及び支点部材の構成例を示す斜視図であり、各図において、支点部材４は、板形状部材２に接する支点部位がほぼ点で接する円錐形状部４ｂであり、上述のように、上記酸化シリコン膜４ｆ、又は、上記シリコン窒化膜４ｇで形成されているから機械的強度が強くなっている。同様に、支点部材４を通して、板形状部材２の電位を取る場合は、各種金属膜等の導電性材料で形成される。

図１５に示すように、支点部材４の上記円錐形状４ｂは、頂点が点形状４b_1を有する。然し、図１６に示すように、板形状部材２に近い個所において、頂点近傍が丸みを有する丸形状４b_2でも良い。
従って、支点部材４が、図示のような上記円錐形状部４ｂであることから、支点部材４の支点部位の基板３側の機械的強度を強めることが出来、且つ、板形状部材２の変位は、板形状部材２の端部における基板３の上面との接触部２ｄで規定されるので、接触面積を極力低減して板形状部材２の基板３への固着や接触帯電を抑制できる。
又、同様に、支点部材４が、板形状部材２と接触する領域において点形状を有することから、静電引力に作用する方向に対応した任意の方向へ板形状部材２を傾斜変位させることが容易となる。

【００６５】
図１７と図１８は本発明の第５の実施形態の断面図、及び平面図であり、同図において、支点部材４は、板形状部材２に接する支点部材４の支点部位の面が長方形の長方形状部４ｃであり、上述のように、上記酸化シリコン膜４ｆ、又は、上記シリコン窒化膜４ｇで形成されているから機械的強度が強くなっている。同様に、支点部材４を通して、板形状部材２の電位を取る場合は、各種金属膜等の導電性材料で形成される。従って、板形状部材２に接する支点部材４の上記長方形状部４ｃが長方形であることから、支点部材４の短尺方向への支点部材４の傾斜変位、即ち、１軸方向の板形状部材２の静電引力による傾斜変位を安定して起こすことが出来る。
図１９乃至図２２は本発明の第６の実施形態の断面図、平面図、及び支点部材の構成例を示す斜視図であり、支点部材４は、板形状部材２に接する支点部材４の支点部位がほぼ線で接する上記斜面４ｄの斜面４d_2を有する尾根の形状からなる尾根形状部４ｅであり、上述のように、上記酸化シリコン膜４ｆ、又は、上記シリコン窒化膜４ｇで形成されているから機械的強度が強くなっている。同様に、支点部材４を通して、板形状部材２の電位を取る場合は、各種金属膜等の導電性材料で形成される。
図２１に示すように、支点部材４の上記尾根形状部４ｅの支点部位は線を頂点とする線形状４e_1であるが、図２２に示すように、頂点近傍が丸みを有する丸形状４e_2でも良い。
板形状部材２に接する支点部材４の上記尾根形状部４ｅの支点部位がほぼ線で接していることから、支点部材４の上記尾根形状部４ｅと板形状部材２の接触面積を低減して１軸方向の板形状部材２の静電引力による傾斜変位を安定して起こすことが出来る。
又、支点部材４の上記尾根形状部４ｅが上記斜面４ｄの斜面４d_2を有する尾根状形状であることから、支点部材４の機械的強度を強め、且つ、板形状部材２の変位は板形状部材２の端部における基板３の上面との上記接触部２ｄで規定されるので、接触面積を極力低減して板形状部材２の基板３への固着や接触帯電を抑制できる。

【００６６】
図２３と図２４において、静電引力を作用させるための電極６は、少なくとも２個以上、例えば、図示のように電極６a_1、電極６a_2、電極６a_3、電極６a_4の４個が、板形状部材２の裏側に対向する支点部材４が形成された基板３上に形成されており、且つ、板形状部材２は電気的に浮いている。電極６a_1、電極６a_2、電極６a_3、電極６a_4の材質としては、導電性などを考慮すると、アルミニウム系金属や窒化チタンやチタン等の金属が望ましい。
図示のように、基板３に形成された２個以上の、例えば、電極６a_1、電極６a_2、電極６a_3、電極６a_4の４個間の電位差に起因した静電引力を、板形状部材２を誘電的に経由して板形状部材２と電極６の各電極６a_1、電極６a_2、電極６a_3、電極６a_4の間に働かせ、板形状部材２を目的の方向へ変位させることが出来る。
更に、引き続き支点部材４がを中心として対向する電極６の各電極６a_1、電極６a_2、電極６a_3、電極６a_4へ任意の電圧を印加することにより、板形状部材２の変位方向を高速で変えることが出来る。
更に、電極６の複数の各電極６a_1、電極６a_2、電極６a_3、電極６a_4間に任意に電

位差を生じさせることが出来、それにより板形状部材２の傾斜の向きを２軸方向で高精度に制御されて、光偏向を行う構造と制御が更に簡単容易で作動が安定で応答も更に速く出来る。

図２５と図２６において、反射手段１の上記反射面１αの光反射領域、又は、板形状部材２の少なくとも一部に導電性を有する導電性領域２ｂが形成され、且つ、上記導電性領域２ｂの少なくとも一部が、電極６と対向している。上記導電性領域２ｂの材質としては、導電性などを考慮すると、アルミニウム系金属や窒化チタンやチタン等の金属が望ましい。更に、上記導電性領域２ｂにより反射手段１の上記反射面１αの光反射領域を兼ねて低コスト化する場合には、反射性能が良好であることが望ましく、その場合には、特に、上記アルミニウム系金属１ｂが望ましい。

図示のように、基板３に形成された２個以上の、例えば、電極６の複数の各電極$6\alpha_1$、電極$6\alpha_2$、電極$6\alpha_3$、電極$6\alpha_4$間の電位差に起因した静電引力を、上記導電性領域２ｂを経由して板形状部材２と電極６の複数の各電極$6\alpha_1$、電極$6\alpha_2$、電極$6\alpha_3$、電極$6\alpha_4$間に働かせ、より低い駆動電圧で板形状部材２を目的の方向へ変位させることが出来る。

更に、引き続き支点部材４の支点部位を中心として電極６の複数の対向する各電極$6\alpha_1$、電極$6\alpha_2$、電極$6\alpha_3$、電極$6\alpha_4$へ任意の電圧を印加することにより、板形状部材２の変位方向を高速で変えることが出来る。

更に、電極６の複数の対向する各電極$6\alpha_1$、電極$6\alpha_2$、電極$6\alpha_3$、電極$6\alpha_4$間に任意に電位差を生じさせることが出来、それにより板形状部材２の傾斜の向きを２軸方向で高精度に制御することが出来る。

【００６７】

図２７と図２８において、光偏向装置０は、入射光を反射する反射手段１と、反射手段１を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材２と、板形状部材２を固定することなく載置する基板３と、基板３上の傾斜する板形状部材２の変位時の支点となる支点部材４と、支点部材４上に板形状部材２を変位が自由の状態で配置される空隙（Ｇ）を形成する笠形状の笠形状部材５の笠形状部材$5\alpha_1$、笠形状部材$5\alpha_2$、笠形状部材$5\alpha_3$、笠形状部材$5\alpha_4$と、基板３上の支点部材４の周囲に板形状部材２の裏面と対向して配置した電極$6\alpha_1$、電極$6\alpha_2$、電極$6\alpha_3$、電極$6\alpha_4$とからなる（図２７を参照）。

そして、光偏向装置０においては、板形状部材２は、固定端を有していないので、その初期の位置を、基板３上の支点部材４上と笠形状の笠形状部材５の笠形状部材$5\alpha_1$、笠形状部材$5\alpha_2$、笠形状部材$5\alpha_3$、笠形状部材$5\alpha_4$間に形成される空隙（Ｇ）内に制限されて変位が自由であるから、電極$6\alpha_1$、電極$6\alpha_2$、電極$6\alpha_3$、電極$6\alpha_4$より最も遠ざかる配置を記載した（図２８を参照）。

図２９と図３０において、光偏向装置０は、初期状態から、板形状部材２を支点部材４上に設置するために、リセット動作を行う。

リセット動作においては、電極$6\alpha_1$、電極$6\alpha_2$、電極$6\alpha_3$、電極$6\alpha_4$よりの電位をそれぞれ電極$6\alpha_1$＝Ｘ（Ｖ）、電極$6\alpha_2$＝０（Ｖ）、電極$6\alpha_3$＝Ｘ／２（Ｖ）、電極$6\alpha_4$＝Ｘ／２（Ｖ）とすることにより、図示の白抜き矢印線で示したような静電引力分布が得られ、白抜き矢印線の大きさにより静電引力の大小を示した。

図示の矢印Ｍ方向に板形状部材２が傾斜し、板形状部材２の少なくとも一部、例えば、板形状部材２の端部の上記接触部２ｄが基板３と接触して、図示のように方向を規定して、リセット方向に反射光が得られる。

尚、ここで印加されるＸ（Ｖ）は、板形状部材２と各電極$6\alpha_1$、電極$6\alpha_2$、電極$6\alpha_3$、電極$6\alpha_4$との間の距離、及び、静電容量などにより決定され、通常の板形状部材２の変位、即ち、支点部材４の支点部位を中心とした傾斜を起こす電圧Ｙ（Ｖ）よりやや大きい電圧となる。

【００６８】

図３１と図３２において、次に、電極$6\alpha_1$、電極$6\alpha_2$、電極$6\alpha_3$、電極$6\alpha_4$より

の電位をそれぞれ電極6α_1＝Y／2（V）、電極6α_2＝Y／2（V）、電極6α_3＝Y（V）、電極6α_4＝0（V）とすることにより、リセット方向と反対方向に高速に図示の矢印N方向に板形状部材2が傾斜し、板形状部材2の少なくとも一部、例えば、板形状部材2の端部の上記接触部2dが基板3と接触して、図示のように方向を規定して、光偏向を行う。

即ち、支点部材4の支点部位を中心とし対向する電極6α_1、電極6α_2、電極6α_3、電極6α_4へ任意の電圧を印加することにより、板形状部材2の変位方向を高速で変えることが出来る。

図33と図34において、電極6α_1、電極6α_2、電極6α_3、電極6α_4の電位をそれぞれ電極6α_1＝Y／2（V）、電極6α_2＝0（V）、電極6α_3＝Y／2（V）、電極6α_4＝Y（V）とすることにより、図31と図32の光偏向（1）とは軸を変えて、高速に板形状部材2が図示の矢印O方向に傾斜変位し、板形状部材2の少なくとも一部、例えば、板形状部材2の端部の上記接触部2dが基板3と接触して、方向を規定して、光偏向（2）を行う。

即ち、板形状部材2の傾斜の向きを2軸方向で高精度に制御することが出来る。

以上のように、電極6の2個以上の電極6α_1、電極6α_2、電極6α_3、電極6α_4間に異なる電位を与えることにより、板形状部材2が静電引力により変位し、即ち、支点部材4の支点部位を中心に傾斜し、入射する光束が反射方向を変えることが出来る。

尚、支点部材4の図示しない上記斜面4dの少なくとも一部に板形状部材2を接触させて光偏向を行うことにより、接触時の衝撃を面で受けることが出来、板形状部材2に及ぼす衝撃を緩和することが出来る。又、支点部材4の図示しない上記斜面4dにより板形状部材2の傾斜の向きを規定でき、傾斜の制御性及び安定性を向上する。

【0069】

図35において、次に、異なる電極6、例えば、電極6α_1と電極6α_2間に異なる電位を与えることにより、静電引力が発生する原理を、板形状部材2上に上記導電性領域2bを配置した効果を含めて、リセット動作時を例に説明する。電極6α_1には、正電位X（V）が印加され、電極6α_2には0（V）が印加されている。この時、両電極6α_1と電極6α_2と電気的に浮いている板形状部材2の間には静電引力が発生し、板形状部材2を電極側に変位させるのであるが、まず電極6α_1に印加された正電位により電極6α_1には正電荷が現れる。そして空隙（G）を介して板形状部材2に誘電的に負電荷が発生し、同時に上記導電性領域2bにおいて導電的に効率よく負電荷が広がる。逆に言うと、上記導電性領域2bにより効率的に板形状部材2に負電荷を発生させる。この時、板形状部材2と上記導電性領域2bは電気的に浮いているので、電極6α_2に空隙（G）を介して対向する板形状部材2と上記導電性領域2bには模式的には正電荷が広がる。その正電荷に対応するように、電極6α_2には模式的に負電荷が発生する、電極6α_2は実際には接地されているが、模式的に考えた場合はそのようになる。それにより、電極6α_2上部に位置する板形状部材2においても静電引力が発生する。

上記説明は一連の流れにて説明したが、必ずしも一連の流れにより起こる訳ではなく、両電極6α_1と電極6α_2の電位差がそれらの現象を同時進行的に発生させる。

尚、実際には、電気的に浮いている板形状部材2と上記導電性領域2bは電極6α_1と電極6α_2の間の任意の電位となり、任意の電位と電極6α_1の電位差による静電引力、及び、任意の電位と電極6α_2の電位差による静電引力が発生することとなる。

この任意の電位は空隙（G）、及び、電極6α_1と電極6α_2の面積などの構造的要因により異なる。このようにして発生した静電引力により、板形状部材2が、電極6α_1、又は、電極6α_2側に変位する。

【0070】

図36と図37において、光偏向装置0において、支点部材4の上記斜面4dの斜面4d$_3$が、板形状部材2のほぼ全域に対応して形成され、且つ、上記斜面4dの上記斜面4d$_3$上に静電引力を作用させるための電極6の少なくとも2個以上の、例えば、電極6α_1、電極6α_2、電極6α_3、電極6α_4を有する。上記斜面4dの上記斜面4d$_3$上から

なる支点部材４の材質としては、同様に、上記酸化シリコン膜４ｆ、又は、上記シリコン窒化膜４ｇである。
図示のように、支点部材４の支点部位に近づくにつれ、電極６を板形状部材２に近接して設置でき、それにより、より大きな静電引力を発生させることが出来る。言い換えると、より低電圧で板形状部材２の変位を可能とする。
又、電極６α_1、電極６α_2、電極６α_3、電極６α_4の全面に接触して、板形状部材２を変位させることが出来るので、接触時の衝撃を分散させることが出来て機械的強度が長期間使用時にも変化と劣化が更に少なくなる。又、電極６α_1、電極６α_2、電極６α_3、電極６α_4の全面に接触して板形状部材２を変位させることにより、板形状部材２の変位方向の制御が容易となり、作動が更に安定で応答も更に速くなる。
図３８と図３９において、光偏向装置０において、反射手段１の上記反射面１αの光反射領域、又は、板形状部材２の少なくとも一部に導電性を有する上記導電性領域２ｂが形成され、且つ、上記導電性領域２ｂの少なくとも一部が電極６α_1、電極６α_2、電極６α_3、電極６α_4と対向している。
上記導電性領域２ｂの材質としては、導電性などを考慮すると、アルミニウム系金属や窒化チタンやチタン等の金属が望ましい。
基板３に形成された電極６の２個以上の、例えば、電極６α_1、電極６α_2、電極６α_3、電極６α_4間の電位差に起因した静電引力を、上記導電性領域２ｂを経由して板形状部材２と電極６の、例えば、電極６α_1、電極６α_2、電極６α_3、電極６α_4間に働かせ、より低い駆動電圧で、板形状部材２を目的の方向へ変位させることが出来る。
更に、引き続き、支点部材４の支点部位を中心として対向する電極６の、例えば、電極６α_1、電極６α_2、電極６α_3、又は、電極６α_4へ任意の電圧を印加することにより、板形状部材２の変位方向を高速で変えることが出来る。
更に、電極６の複数の、例えば、電極６α_1、電極６α_2、電極６α_3、又は、電極６α_4間に任意に電位差を生じさせることが出来る。
【００７１】
図４０と図４１において、光偏向装置０は、基板３上に形成された窪み形状の窪み形状部３αを有し、且つ、上記窪み形状部３αの任意の箇所に支点部材４の上記斜面４dの上記斜面４d_4、及び、電極６の、例えば、電極６α_1、電極６α_2、電極６α_3、又は、電極６α_4を有し、且つ、笠形状部材５を上記基板５の平面上部に有し、且つ、笠形状部材５と上記窪み形状部３αにより構成される空隙（Ｇ）に板形状部材２を有し、且つ、板形状部材２は電気的に浮いており、且つ、支点部材４と板形状部材２が接触する個所、即ち、支点部材４の頂点が、基板３の上面より窪み形状部３α側に低く形成されている。
窪み形状部３α、及び、支点部材４は、基板３をエッチング加工することにより形成されるが、基板３上に厚く絶縁膜３ｃを形成後、これを加工しても良い。支点部材４の頂点、即ち、板形状部材２の変位の支点部位は、上記加工時に基板３の表面より低く形成することが可能である。
尚、上記該光偏向装置０の製造方法は後述するが、板形状部材２の可動範囲を制限する空隙（Ｇ）の下方部を基板３の上記窪み形状部３αに構成されているため、笠形状部材５の高さを低く出来る。
笠形状部材５は、板形状部材２を空隙（Ｇ）に留めるために衝突等の衝撃を受ける。
そのため、機械的強度を高めることが重要で、笠形状部材５を低く形成することは、笠形状部材５自体の自立安定につながり、ひいては機械的強度を高めることになる。
又、後述する製造方法により歩留まりも向上し、光偏向装置０の空隙（Ｇ）は、基板３に形成した上記窪み形状部３αの深さと図示しない第２の犠牲層７ｂの膜厚により規定することが出来、図示しない第１犠牲層７αの平坦化の割合に大きく依存しないため、但し、基板３に至る平坦化は少なくとも必要で、空隙（Ｇ）の高さの制御性を向上でき、駆動電圧、及び、リセット電圧の制御性が良くなった。
【００７２】
図４２乃至図４４は本発明の第１１の実施形態を示す光偏向装置の一単位の断面図、平面

図、及び集合状態を示す平面図である。各図において、光偏向装置０において、板形状部材２が、図示のように外形が円形状である（図４３を参照）。
板形状部材２が図示のように円形状であることから、板形状部材２に組み合わされた反射手段１の上記反射面１αの反射領域にて反射した反射光が円形となり、光偏向装置０を具備する図示しない上記画像形成装置２００、及び、図示しない上記画像投影装置３００等における１画素を円形状とすることが出来る。それにより、隣接画素の隙間部をドット状に点在させることが出来る（図４４を参照）。従って、矩形な板形状部材２による矩形な画素形状の隣接画素の隙間部が線状の筋となるのと異なり、高精彩な画像を得ることが出来る。
図４５と図４６は他の実施形態の断面図、及び平面図であり、この光偏向装置０においては、笠形状部材５が、板形状部材２の外周に対応する任意の個所に、例えば、笠形状部材５α_1、笠形状部材５α_2、笠形状部材５α_3、笠形状部材５α_4が間隔（ℊ）を空けて複数個設置されている。後述する光偏向装置０の製造方法における、図示しない犠牲層７のエッチング除去を複数の間隔（ℊ）部から開始することが可能なので、図示しない上記犠牲層７のエッチング除去時に要する時間を短縮化できる。
エッチング除去時には、板形状部材２や基板３がエッチング液に晒されるので、そのエッチング時間が短くなることにより、歩留の向上が得られる。
【００７３】
図４７と図４８は第１３の実施形態の断面図、及び平面図であり、光偏向装置０においては、笠形状部材５が、板形状部材２の外周に対応する個所全領域に設置されている。笠形状部材５が、板形状部材２の全周に渡って連続配置されていることから、板形状部材２が機械的に可動範囲を制限された空隙（Ｇ）よりはみ出し、光偏向装置０が故障することを極力低減するから、作動が更に安定で機械的強度が長期間使用時にも変化と劣化が更に少なくすることが出来る。
次に、光偏向装置０における笠形状部材５が絶縁性を有する絶縁膜５ｂにより構成されている。前述のように、笠形状部材５は、板形状部材２を任意の空隙（Ｇ）に留めるために、板形状部材２と接触する。そのため、笠形状部材５が導電性であると、電気的に浮いている板形状部材２の電位が変動する危険性が高い。即ち、板形状部材２が笠形状部材５に接触した場合でも、電気的に浮いている板形状部材２の電荷が笠形状部材５を経由して移動しないので板形状部材２の電位が変動することを抑制できる。
次に、光偏向装置０において、笠形状部材５が、入射光束に対し透光性を有する透光性膜５ｃにより構成されて、特に、上記酸化シリコン膜５ｄにより構成されている。笠形状部材５を上記透光性膜５ｃとすることにより、板形状部材２と組み合わせ構成される反射手段１の上記反射面１αの光反射領域の笠形状部材５と重なる領域からの反射光も寄与させることが出来るので、１素子における反射光の面積、及び、光量を増加させることが出来る。即ち、ＯＮ光量が増大するから、光偏向を行う構造と制御が更に簡単容易で作動が更に安定で応答も更に速くさせることが出来る、
更に、笠形状部材５を上記酸化シリコン膜５ｄとすることにより、高い絶縁性と高い透光性を両立した笠形状部材５を提供でき、後述する光偏向装置０の製造方法において、微細化と集積化の作製が可能となり、構造と制御が更に簡単容易で作動が更に安定で応答も更に速く、微細化と集積化が更に可能で更に低コスト化が出来る。
【００７４】
次に、光偏向装置０における笠形状部材５が、入射光束に対し遮光性を有する遮光性膜５ｅにより構成されて、特に、酸化クロム膜５ｆにより構成されている。笠形状部材５を上記遮光性膜５ｅとすることにより、笠形状部材５に入射した光束の望まれない方向への反射を抑制することができる。それにより、目的方向への光偏向の迷光を低下させることが出来る。迷光は、目的方向への光偏向を行っていない場合にも生じる成分なので、ＯＦＦ光量が抑制されて、光偏向を行う構造と制御が更に簡単容易で作動が更に安定になる。
更に、笠形状部材５を上記酸化クロム膜５ｆとすることにより、高い絶縁性と高い遮光性を両立した笠形状部材５を提供でき、後述する光偏向装置０の製造方法において、微細化

と集積化の作製が可能となり、光偏向を行う構造と制御が更に簡単容易で作動が更に安定で応答も更に速く、更に低コストとなる。
次に、光偏向装置０において、板形状部材２が、シリコン窒化膜２ｃにより構成され、且つ、板形状部材２に組み合わせ構成される反射手段１の上記反射面１αの光反射領域が高い導電性を有し、且つ、高い反射性を有する上記アルミニウム系金属膜１ｂにより構成されている。
上記シリコン窒化膜２ｃの板形状部材２は、高い絶縁破壊電圧を有し、且つ、長期的な劣化、即ち、繰り返し変位に伴う疲労に対する耐性も高いので極力軽量、及び、薄膜化でき、それにより高い周波数における駆動が可能な、即ち、数１０ｋＨｚ以上の高速動作が可能となる。
又、反射手段１の上記反射面１αの光反射領域を高い反射性能と高い導電性を両立する上記アルミニウム系金属膜１ｂとすることにより、上記導電性領域２ｂと兼ねることができ、それにより、光偏向装置０の光偏向動作、即ち、板形状部材２の変位を、より高い反射光量を得ながら低電圧にて行うことが出来る。
【００７５】
図４９と図５０において、光偏向装置０は、複数個を１次元アレー形状に配列した１次元光偏向アレー１０として、図示しない上記画像形成装置２００における図示しない潜像形成手段２０２等に使用することが出来る（図４９を参照）。更に、上記１次元光偏向アレー１０を複数組み合わせて、２次元アレー形状に配列した２次元光偏向アレー２０として、図示しない上記画像投影表示装置３００における光スイッチ手段３０１等に使用することが出来る（図５０を参照）。
【００７６】
図５１乃至図５９において、光偏向装置０は、次のように、基板３上に支点部材４と電極６の複数個、例えば、電極$６\alpha_1$、電極$６\alpha_2$、電極$６\alpha_3$、又は、電極$６\alpha_4$を形成し、堆積して平坦化した上記第１の犠牲層７αを介して反射手段１を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材２を形成して、更に、堆積した上記第２の犠牲層７ｂとをパターン化した所定の位置に笠形状部材５をパターン化した後に、上記第１の犠牲層７αと上記第２の犠牲層７ｂをエッチングにより除去するから、入射光の反射方向を１軸、又は、２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置０の製造方法を提供することが出来るようになった。
基板上支点部材形成工程（α_1）において、上記（１００）面方位を有するシリコン基板３ｂの基板３上に、支点部材４を構成する上記酸化シリコン膜４ｆがプラズマＣＶＤ法により堆積され、その後、面積階調を有するパターンを形成したフォトマスクを用いた写真製版法やレジストパターン形成後熱変形させる写真製版法により、支点部材４の形状とほぼ同形状の任意の膜厚を有するレジストパターンを形成し、その後、ドライエッチング法の手法により目的形状の支点部材４が形成される。
尚、上記（１００）面方位を有するシリコン基板３ｂ上に２μｍ程度の酸化シリコン膜を形成し、その上層１μｍ程度にて同様の加工を行っても良い。
又、支点部材４の支点部位の頂点における高さは、およそ１μｍである（図５１を参照）。
【００７７】
電極形成工程（α_2）において、電極６の複数個、例えば、電極$６\alpha_1$、電極$６\alpha_2$、電極$６\alpha_3$、又は、電極$６\alpha_4$を窒化チタン（ＴｉＮ）膜の薄膜で形成する。
ＴｉＮ薄膜は、Ｔｉをターゲットとしたマグネトロンスパッタ法により、厚さ０．０１μｍに成膜し、写真製版法、及び、ドライエッチング法の手法により複数の、例えば、電極$６\alpha_1$、電極$６\alpha_2$、電極$６\alpha_3$、電極$６\alpha_4$としてパターン化した（図５２を参照）。
保護膜形成工程（α_3）において、電極６の複数個、例えば、電極$６\alpha_1$、電極$６\alpha_2$、

電極６α_3、又は、電極６α_4の保護膜６ｂとして、プラズマＣＶＤ法によるシリコン窒化膜を膜厚０．２μｍで形成した（図５３を参照）。
第１の犠牲層形成工程（α_4）において、非晶質なシリコン膜をスパッタ法により２μｍ堆積させ、ＣＭＰ技術を用いて処理時間制御にて平坦化した。この時、支点部材４の頂点上に残る非晶質シリコン膜の膜厚を０．１μｍとなる時間にて処理した。残存する非晶質シリコン膜が上記第１の犠牲層７αである。
尚、上記第１の犠牲層７αとしては、上記膜以外にもポリイミド膜や感光性有機膜、一般的に半導体プロセスにて用いられるレジスト膜や多結晶シリコン膜などを用いることも出来、平坦化の手法としては、熱処理によるリフロー法やドライエッチングによるエッチバック法を用いることも出来る（図５４を参照）。
反射手段と板形状部材形成工程（α_5）において、板形状部材２となる上記シリコン窒化膜２ｃをプラズマＣＶＤ法により厚さ０．２μｍで堆積させ、引き続き、反射手段１の上記反射面１αの光反射領域を兼ねる上記導電性領域２ｂとなる上記アルミニウム系金属膜１ｂを０．０５μｍの厚さでスパッタリング技術により堆積させた。その後、上記導電性領域２ｂ、及び、板形状部材２をそれぞれ写真製版法、及び、ドライエッチング法によりパターン化した（図５５を参照）。
【００７８】
第２の犠牲層形成工程（α_6）において、非晶質なシリコン膜をスパッタ法により１μｍ堆積させ、上記第２の犠牲層７ｂとした。尚、上記第２の犠牲層７ｂとしては、上記膜以外にもポリイミド膜や感光性有機膜、一般的に半導体プロセスにて用いられるレジスト膜や多結晶シリコン膜などを用いることも出来る（図５６を参照）。
笠形状部材パターン化工程（α_7）において、光偏向装置０を個別に分離し、反射手段１を組み合わせ構成する板形状部材２の周囲に、図示しない笠形状部材５を配置するために、写真製版法、及び、ドライエッチング法により、上記第１の犠牲層７α、及び、上記第２の犠牲層７ｂを同時に、反射手段１を組み合わせ構成する板形状部材２よりやや広くパターン化した（図５７を参照）。
笠形状部材形成工程（α_8）において、笠形状部材５を構成する上記酸化シリコン膜５ｄをプラズマＣＶＤ法により厚さ０．８μｍで堆積させ、写真製版法、及び、ドライエッチング法により、パターン化して、笠形状部材５を形成した。尚、笠形状部材５は、図示のような形状に留まらず、図６０、又は、図６１に図示するような形状を取ることも出来る（図５８を参照）。
犠牲層除去工程（α_9）において、残存する上記第１の犠牲層７α、及び、上記第２の犠牲層７ｂを、ウェットエッチング技術により開口部を通してエッチング除去し、反射手段１を組み合わせ構成する板形状部材２を可動範囲が制限された空隙（Ｇ）に配置して、光偏向装置０が完成する。
尚、笠形状部材５が、板形状部材２の外周に対応して複数個の例えば、各笠形状部材５α_1、笠形状部材５α_2、笠形状部材５α_3、笠形状部材５α_4を所定の間隔（ｇ）を空けて配置することにより、間隔（ｇ）部には上記犠牲層７の上記第１の犠牲層７α、及び、上記第２の犠牲層７ｂが、３次元的に露出しているので、エッチングがより短時間で終了できる（図５９を参照）。
【００７９】
図６２乃至図７１は本発明の他の実施形態に係る光偏向装置の製造手順を示す図であり、光偏向装置０は、次のように、基板３上に支点部材４と電極６を複数個、例えば、電極６α_1、電極６α_2、電極６α_3、又は、電極６α_4を形成し、支点部材４を突出させて堆積して平坦化した上記第１の犠牲層７αに重ねて堆積して平坦化した第３の犠牲層７ｃを介して反射手段１を表面に組み合わせ構成する薄膜で形成された湾曲形状の上記湾曲形状部２αからなる板形状部材２を形成して、更に、堆積した上記第２の犠牲層７ｂとをパターン化した所定の位置に笠形状部材５をパターン化した後に、上記犠牲層７の上記第１の犠牲層７αと上記第２の犠牲層７ｂと上記第３の犠牲層７ｃをエッチングにより除去するから、静電引力により板形状部材２が傾斜変位する時に、板形状部材２の変位時に上記湾

曲形状部２αを中心とた変位が可能となり、板形状部材２がずれることを抑制し、言い換えると、支点部材４に対する板形状部材２の位置決めが自発的に容易となり、板形状部材２の変位時に、板形状部材２が笠形状部材５の側面に接触することを抑制して、入射光の反射方向を１軸、又は、２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が更に安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が更に少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置０の製造方法を提供することが出来るようになった。

基板上支点部材形成工程（b_1）において、上記（１００）面方位を有するシリコン基板３ｂの基板３上に、支点部材４を構成する上記酸化シリコン膜４ｆがプラズマＣＶＤ法により堆積され、その後、面積階調を有するパターンを形成したフォトマスクを用いた写真製版法やレジストパターン形成後熱変形させる写真製版法により、支点部材４の形状とほぼ同形状の任意の膜厚を有するレジストパターンを形成し、その後、ドライエッチング法の手法により目的形状の支点部材４が形成される。

尚、上記（１００）面方位を有するシリコン基板３ｂ上に２μｍ程度の酸化シリコン膜を形成し、その上層１μｍ程度にて同様の加工を行っても良い。

又、支点部材４の支点部位の頂点における高さは、およそ１μｍである（図６２を参照）。

【００８０】

電極形成工程（b_2）において、電極６の複数個、例えば、電極６α_1、電極６α_2、電極６α_3、又は、電極６α_4を窒化チタン（ＴｉＮ）膜の薄膜で形成する。

ＴｉＮ薄膜は、Ｔｉをターゲットとしたｄｃマグネトロンスパッタ法により、厚さ０．０１μｍに成膜し、写真製版法、及び、ドライエッチング法の手法により複数の、例えば、電極６α_1、電極６α_2、電極６α_3、電極６α_4としてパターン化した（図６３を参照）。

保護膜形成工程（b_3）において、電極６の複数個、例えば、電極６α_1、電極６α_2、電極６α_3、又は、電極６α_4の上記保護膜６ｂとして、プラズマＣＶＤ法によるシリコン窒化膜を膜厚０．２μｍで形成した（図６４を参照）。

第１の犠牲層形成工程（b_4）において、非晶質なシリコン膜をスパッタ法により２μｍ堆積させ、ＣＭＰ技術を用いて支点部材４が露出し、更に、時間をオーバーさせて平坦化した。この時、支点部材４、及び、上記保護膜６ｂとの研磨選択性の高いＣＭＰ条件とすることにより、支点部材４の頂点近傍では支点部位が残存し、非晶質シリコン膜がやや低く残存する。支点部材４の支点部位が約０．２μｍ突出した。残存する非晶質シリコン膜が上記第１の犠牲層７αである。尚、上記第１の犠牲層７αとしては、上記膜以外にもポリイミド膜や感光性有機膜、一般的に半導体プロセスにて用いられるレジスト膜や多結晶シリコン膜などを用いることも出来、平坦化の手法としては、ドライエッチングによるエッチバック法を用いることも出来る（図６５を参照）。

【００８１】

第３の犠牲層形成工程（b_5）において、非晶質なシリコン膜をスパッタ法により０．１μｍ堆積させ、上記第３の犠牲層７ｃとした（図６６を参照）。

反射手段と板形状部材形成工程（b_6）において、板形状部材２となる上記シリコン窒化膜２ｃをプラズマＣＶＤ法により厚さ０．２μｍで堆積させ、引き続き、反射手段１の上記反射面１αの光反射領域を兼ねる上記導電性領域２ｂとなる上記アルミニウム系金属膜１ｂを０．０５μｍの厚さでスパッタリング技術により堆積させた。その後、上記導電性領域２ｂ、及び、板形状部材２をそれぞれ写真製版法、及び、ドライエッチング法によりパターン化した（図６７を参照）。

第２の犠牲層形成工程（b_7）において、非晶質なシリコン膜をスパッタ法により１μｍ堆積させ、上記第２の犠牲層７ｂとした。尚、上記第２の犠牲層７ｂとしては、上記膜以外にもポリイミド膜や感光性有機膜、一般的に半導体プロセスにて用いられるレジスト膜や多結晶シリコン膜などを用いることも出来る（図６８を参照）。

笠形状部材パターン化工程（b_8）において、光偏向装置０を個別に分離し、反射手段１を組み合わせ構成する板形状部材２の周囲に、図示しない笠形状部材５を配置するために、写真製版法、及び、ドライエッチング法により、上記第１の犠牲層７ａ、及び、上記第２の犠牲層７ｂ、上記第３の犠牲層７ｃを同時に、反射手段１を組み合わせ構成する板形状部材２よりやや広くパターン化した（図６９を参照）。

笠形状部材形成工程（b_9）において、笠形状部材５を構成する上記酸化シリコン膜５ｄをプラズマＣＶＤ法により厚さ０．８μｍで堆積させ、写真製版法、及び、ドライエッチング法により、パターン化して、笠形状部材５を形成した。尚、笠形状部材５は、図示のような形状に留まらず、図６０、又は、図６１に図示するような形状を取ることも出来る（図７０を参照）。

犠牲層除去工程（b_{10}）において、残存する上記第１の犠牲層７ａ、上記第２の犠牲層７ｂ、及び、上記第３の犠牲層７ｃを、ウェットエッチング技術により開口部を通してエッチング除去し、反射手段１を組み合わせ構成する板形状部材２を可動範囲が制限された空隙（Ｇ）に配置して、光偏向装置０が完成する。尚、笠形状部材５が、板形状部材２の外周に対応して複数個の例えば、各笠形状部材５a_1、笠形状部材５a_2、笠形状部材５a_3、笠形状部材５a_4を所定の間隔（δ）を空けて配置することにより、間隔（δ）部には上記犠牲層７の上記第１の犠牲層７ａ、上記第２の犠牲層７ｂ、及び、上記第３の犠牲層７ｃが、３次元的に露出しているので、エッチングがより短時間で終了できる（図７１を参照）。

【００８２】

図７２乃至図８０は本発明の更に他の実施形態に係る光偏向装置の製造手順を示す図であり、この光偏向装置０は、次のように、基板３上に上記窪み形状部３ａと上記窪み形状部３ａ内に上記斜面４ｄの斜面４d_4からなる支点部材４と電極６の複数個、例えば、電極６a_1、電極６a_2、電極６a_3、又は、電極６a_4を形成し、堆積して平坦化した上記第１の犠牲層７ａを介して反射手段１を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材２を形成して、更に、堆積した上記第２の犠牲層７ｂとをパターン化した所定の位置に笠形状部材５をパターン化した後に、上記第１の犠牲層７ａと上記第２の犠牲層７ｂをエッチングにより除去するから、笠形状部材５の高さが低くなり、笠形状部材５自体の自立安定につながり、入射光の反射方向を１軸、又は、２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が更に少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置０の製造方法を提供することが出来るようになった。

基板上窪み形状部と支点部材形成工程（c_1）において、上記（１００）面方位を有するシリコン基板３ｂの基板３上に、面積階調や濃度階調を有するパターンを形成したフォトマスクを用いた写真製版法により、上記窪み形状部３ａ、及び、支点部材４の形状とほぼ同形状の任意の膜厚を有するレジストパターンを形成し、その後、ドライエッチング法の手法により上記（１００）面方位を有するシリコン基板３ｂの基板３上を エッチング加工する。その後、上記（１００）面方位を有するシリコン基板３ｂの基板３との絶縁性を取るために、支点部材４を構成する上記酸化シリコン膜４ｆを約１μｍプラズマＣＶＤ法により堆積させる。以上の工程により、目的形状の上記窪み形状部３ａ、及び、支点部材４が形成される。

尚、上記（１００）面方位を有するシリコン基板３ｂ上に２μｍ程度の酸化シリコン膜を形成し、その上層１μｍ程度にて同様の加工を行っても良い。上記窪み形状部３ａの最大深さは、およそ３μｍであり、支点部材４の支点部位の頂点における深さはおよそ０．３μｍである（図７２を参照）。

【００８３】

電極形成工程（c_2）において、電極６の複数個、例えば、電極６a_1、電極６a_2、電極６a_3、又は、電極６a_4を窒化チタン（ＴｉＮ）膜の薄膜で形成する。ＴｉＮ薄膜は、Ｔｉをターゲットとしたｄｃマグネトロンスパッタ法により、厚さ０．０１μｍに成膜

し、写真製版法、及び、ドライエッチング法の手法により複数の、例えば、電極6a_1、電極6a_2、電極6a_3、電極6a_4としてパターン化した（図７３を参照）。
保護膜形成工程（c_3）において、電極６の複数個、例えば、電極6a_1、電極6a_2、電極6a_3、又は、電極6a_4の上記保護膜６ｂとして、プラズマＣＶＤ法によるシリコン窒化膜を膜厚０．２μｍで形成した（図７４を参照）。
第１の犠牲層形成工程（c_4）において、非晶質なシリコン膜をプラズマＣＶＤ法により２μｍ堆積させ、ＣＭＰ技術を用いて上記（１００）面方位を有するシリコン基板３ｂの基板３、及び、上記保護膜６ｂをエッチングストッパ層として研磨し平坦化した。
この時、該エッチングストッパ層の効果により、上記窪み形状部３ａ内の非晶質なシリコン膜はオーバー研磨をほとんど生じることなく高い制御性を有して平坦化が可能である。
支点部材４の支点部位の頂点上に残る非晶質シリコン膜の膜厚はおよそ０．２μｍとなった。上記窪み形状部３ａ内に残存する非晶質シリコン膜が上記第１の犠牲層７ａである。
尚、上記第１の犠牲層７ａとしては、上記膜以外にもポリイミド膜や感光性有機膜、一般的に半導体プロセスにて用いられるレジスト膜や、多結晶シリコン膜などを用いることも出来、平坦化の手法としては、熱処理によるリフロー法やドライエッチングによるエッチバック法を用いることも出来る（図７５を参照）。
反射手段と板形状部材形成工程（c_5）において、板形状部材２となる上記シリコン窒化膜２ｃをプラズマＣＶＤ法により厚さ０．２μｍで堆積させ、引き続き、反射手段１の上記反射面１ａの光反射領域を兼ねる上記導電性領域２ｂとなる上記アルミニウム系金属膜１ｂを０．０５μｍの厚さでスパッタリング技術により堆積させた。その後、上記導電性領域２ｂ、及び、板形状部材２をそれぞれ写真製版法、及び、ドライエッチング法によりパターン化した（図７６を参照）。
【００８４】
第２の犠牲層形成工程（c_6）において、非晶質なシリコン膜をスパッタ法により１μｍ堆積させ、上記第２の犠牲層７ｂとした。尚、上記第２の犠牲層７ｂとしては、上記膜以外にもポリイミド膜や感光性有機膜、一般的に半導体プロセスにて用いられるレジスト膜や多結晶シリコン膜などを用いることも出来る（図７７を参照）。
笠形状部材パターン化工程（c_7）において、光偏向装置０を個別に分離し、反射手段１を組み合わせ構成する板形状部材２の周囲に、図示しない笠形状部材５を配置するために、写真製版法、及び、ドライエッチング法により、上記第１の犠牲層７ａ、及び、上記第２の犠牲層７ｂを同時に、反射手段１を組み合わせ構成する板形状部材２よりやや広くパターン化した（図７８を参照）。
笠形状部材形成工程（c_8）において、笠形状部材５を構成する上記酸化シリコン膜５ｄをプラズマＣＶＤ法により厚さ０．８μｍで堆積させ、写真製版法、及び、ドライエッチング法により、パターン化して、笠形状部材５を形成した。尚、笠形状部材５は、図示のような形状に留まらず、図６０、又は、図６１に図示するような形状を取ることも出来る（図７９を参照）。
犠牲層除去工程（c_9）において、残存する上記第１の犠牲層７ａ、及び、上記第２の犠牲層７ｂを、ウェットエッチング技術により開口部を通してエッチング除去し、反射手段１を組み合わせ構成する板形状部材２を可動範囲が制限された空隙（Ｇ）に配置して、光偏向装置０が完成する。
尚、笠形状部材５が、板形状部材２の外周に対応して複数個の例えば、各笠形状部材5a_1、笠形状部材5a_2、笠形状部材5a_3、笠形状部材5a_4を所定の間隔（ｇ）を空けて配置することにより、間隔（ｇ）部には上記犠牲層７の上記第１の犠牲層７ａ、及び、上記第２の犠牲層７ｂが露出しているので、エッチングがより短時間で終了できる（図８０を参照）。
【００８５】
図８１において、電子写真プロセスで光書き込みを行なって画像を形成する上記画像形成装置２００は、図示の矢印（Ｖ）方向に回動可能に保持されて形成画像を担持する画像担持体２０１のドラム形状の感光体と、帯電手段２０５で均一に帯電された上記画像担持体

２０１のドラム形状の感光体上を、上記１次元光偏向アレー１０の複数個の各光偏向装置０を各々独立に駆動する独立駆動手段１０１とからなる上記光情報処理装置１００からなる上記潜像形成手段２０２で光書き込みを行なって潜像を形成し、上記潜像形成手段２０２の上記１次元光偏向アレー１０の各光偏向装置０によって形成された潜像を現像手段２０３で顕像化してトナー画像を形成し、上記現像手段２０３で形成されたトナー画像を転写手段２０４で被転写体（Ｐ）の転写紙に転写して、被転写体（Ｐ）の転写紙に転写されたトナー画像を定着手段２０６で定着した後に、被転写体（Ｐ）の転写紙を排紙トレイ２０７に排紙して収納される。
他方、トナー画像を上記転写手段２０４で被転写体（Ｐ）の転写紙に転写した後の上記画像担持体２０１のドラム形状の感光体は、クリーニング手段２０８でクリーニングされて次工程の画像形成に備えるようになっている。
【００８６】
上記潜像形成手段２０２における上記光情報処理装置１００は、光源１０２からの入射光束（Ｒ）は第１のレンズシステム１０３を介して、上記１次元光偏向アレー１０の複数個の各光偏向装置０に照射され、上記１次元光偏向アレー１０の複数個の各上記光変調装置０は、上記独立駆動手段１０１により、画像情報に応じて独立して個々の入射光を反射する反射手段１を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材２を、基板３上に固定することなく基板３上の支点部材４上と笠形状の笠形状部材５間に形成される空隙（Ｇ）内に変位が自由の状態で配置して、基板３上の支点部材４の周囲に板形状部材２と対向して配置した電極６に電位を付与して、支点部材４上に傾斜して載置する板形状部材２上の反射手段１で入射光の反射方向を変えて光偏向を行なって、反射手段１を通じて入射光束（Ｒ）を第２のレンズシステム１０４を通じて上記画像担持体２０１のドラム形状の感光体上の表面に、構造と制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制して、結像する。
尚、上記１次元光偏向アレー１０は、シリコンウエハーを基板として、上述の製造方法と同様の方法で形成した。
従って、入射光の反射方向を１軸、又は、２軸方向に変えて光偏向を行う構造と光書込み時のＯＮ、及び、ＯＦＦ等の制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制でき、作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置０を具備して、構造と制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制する光偏向装置０を具備する上記光情報処理装置１００、及び、光書き込み時のＯＮ／ＯＦＦ制御が良好で高速動作が可能で、且つ、長期的な信頼性が高く、低電圧で駆動され、Ｓ／Ｎ比も向上出来る高速で高精彩な画像を形成する上記画像形成装置２００を提供することが出来るようになった。
【００８７】
図８２において、画像を投影して表示する上記画像投影表示装置３００は、投影画像データの入射光束（Ｒ）の反射方向を変えて光偏向を行なって画像を投影する、上記２次元光偏向アレー２０の複数個の各光偏向装置０を各々独立に駆動する上記独立駆動手段１０１とからなる上記光情報処理装置１００からなる光スイッチ手段３０１の各上記光変調装置０が画像を投影スクリーン３０２に投影して表示するようになっている。
上記光スイッチ手段３０１における上記光情報処理装置１００は、上記光源１０２からの入射光束（Ｒ）を上記２次元偏向アレー２０に配列された複数個の各光偏向装置０に照射して、上記独立駆動手段１０１により所望の画像のデータを各々の板形状部材２に組み合わせ構成された反射手段１により反射し、投影レンズ１０５、及び、絞り１０６を介して上記投影スクリーン３０２に、構造と画像投影データの表示、即ち、画素の明暗時のＯＮ、及び、ＯＦＦ等の制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制して、投影する。
カラー表示を行うためには、上記光源１０２の前に回転カラーホール１０７を設けたり、

又、性能向上のためにマイクロレンズアレー１０８を用いることも出来る。
尚、上記２次元光偏向アレー２０は、シリコンウエハーを基板として、上述の製造方法と同様の方法で形成した。
従って、入射光の反射方向を１軸、又は、２軸方向に変えて光偏向を行う構造と画像投影データの表示、即ち、画素の明暗時のＯＮ、及び、ＯＦＦ等の制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制でき、作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置０を具備して、構造と制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制する上記光情報処理装置１００、及び、画像の明暗制御時のＯＮ／ＯＦＦ制御が良好で高速動作が可能で、且つ、長期的な信頼性が高く、低電圧で駆動され、コントラスト比も向上出来るので、高輝度でありながら高いコントラストを有する高精細な画像を投影して表示する上記画像投影表示装置３００を提供することが出来るようになった。
【００８８】
図８３において、光信号の光路を決定して出力して伝送する光伝送装置４００は、光信号を入力する光信号入力手段４０１と、上記光信号入力手段４０１からの光信号の入射光の反射方向を１軸、又は、２軸方向に変えて光偏向を行なって、各光信号の光路を決定する上記２次元光偏向アレー２０の光偏向装置０からなる光スイッチ手段４０２と、上記光スイッチ手段４０２からの光信号を出力する光信号出力手段４０３とからなり、光信号の光路を決定して出力して伝送するようになっている。
上記光スイッチ手段４０２は、上記光信号入力手段４０１が有する１個、又は、複数個の信号入力伝達ポート４０１α、例えば、信号入力伝達ポート４０１α_1、信号入力伝達ポート４０１α_2、信号入力伝達ポート４０１α_3から入力された光情報信号を、２段に配置された各上記２次元光偏向アレー２０の２次元光偏向アレー２０αと２次元光偏向アレー２０βに配列された複数個の各光偏向装置０により１軸、又は、２軸方向に偏向され、所定の出力ポートを選択し決定して、複数の信号出力伝達ポート４０３α、例えば、信号出力伝達ポート４０３α_1、信号出力伝達ポート４０３α_2、信号出力伝達ポート４０３α_3を有する上記光信号出力手段４０３から出力して、構造と出力光情報信号のポートを決定する選択等の制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制して、伝送する。
上記光スイッチ手段４０２は、上記２次元光偏向アレー２０を２段に配置して、光偏向角を大きく取っているが、選択するポートの数等によっては、上記２次元光偏向アレー２０は１個でも良い。
又、各上記２次元光偏向アレー２０の２次元光偏向アレー２０αと２次元光偏向アレー２０βに配列された、複数個の各光偏向装置０を同時に、且つ、独立して駆動制御するための制御装置４０２αの各制御装置４０２α_1と各制御装置４０２α_1がそれぞれ具備されている。
従って、入射光の反射方向を１軸、又は、２軸方向に変えて光偏向を行う構造と出力光情報信号のポートを決定する選択等の制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制でき、作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置０を具備して、構造と制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制し、２軸方向の光偏向を容易に正確に行なうことが出来、各ポートの選択の制御が良好で隣接ポートへの迷光、を抑制して、高速な光路切替が可能で、長期的な信頼性が高く、低電圧で駆動され、同一基板上に集積化が出来るので、小型でありながら高速で誤動作の少ない光信号の光路を決定して出力して伝送する上記光伝送装置４００を提供することが出来るようになった。
【００８９】

図８４は本発明の第１６の実施形態を示す光偏向装置の主要部を説明するための平面図である。
図８５は図８４のＡ－Ａ’線断面図である。
図において、支点部材４は、板形状部材２に接する支点部位がほぼ点で接する四角錐形状であり、上述のように、上記酸化シリコン膜、又は、上記シリコン窒化膜で形成されているから機械的強度が強くなっている。頂部はとがっていても構わないが、先端部を半球状にしておけば、応力集中が弱められる。
【００９０】
図８６は本発明の第１７の実施形態を示す光偏向装置の主要部を説明するための平面図である。
図８７は図８６のＡ－Ａ’線断面図である。
図において、支点部材４は板形状部材２に接する支点部位がほぼ点で接する四角錐形状である点では上記と同様であるが、異なる点は、四角錐の底面の大きさが板形状部材２とほぼ同程度の大きさになっている点である。したがって、板形状部材２が静電力を受けて傾斜したとき、板形状部材２の裏面が支点部材４の４つの斜面の内の１つの斜面に密接し、非常に安定した位置を保つ。
【００９１】
図８８は本発明の第１８の実施形態を示す光偏向装置の主要部を説明するための平面図である。
図において、符号$6\alpha_1$ないし$6\alpha_8$は８つの電極を示す。
光偏向装置０は図４３に示した実施形態と同様、外形と板形状部材２が円形に構成されている。この実施形態においては、支点部材４が８角錐に形成されている。８つの電極$6\alpha_1$～$6\alpha_8$は８角錐の各斜面に対応して設けられていて、互いに絶縁されている。いま仮に、電極$6\alpha_1$～$6\alpha_5$＝Ｙ／２（Ｖ）、電極$6\alpha_6$＝Ｙ（Ｖ）、$6\alpha_7$＝Ｙ／２（Ｖ）、電極$6\alpha_8$＝０（Ｖ）とすることにより、板形状部材２は電極$6\alpha_6$と板形状部材２の間、及び、板形状部材２と電極$6\alpha_8$の間に働く静電引力に引かれるが、両者の中間に別の斜面があるため、電極$6\alpha_7$の側に傾斜する。
【００９２】
８角錐の底面の大きさを板形状部材２の大きさにほぼ等しくしておくと、板形状部材２の裏面が傾斜部に当接密着して光の反射方向が安定する。なお、図４３では笠形状部材５が円形の基板の全周に設けられているが、本実施形態では離散的に４カ所に設けられている。どちらにする方がよいかは、アレーに構成する場合の全体の構成の都合で決めればよい。
本実施形態においては、支点部材４は多角錐であれば、例えば６角錐でも、７角錐でも、或いは１０角錐でも構わない。６角錐の場合は３つの軸方向に変えて光偏向を行うことができる。同様に、８角錐であれば４軸、１０角錐であれば５軸方向に変えて光偏向を行うことができる。
更に言えば、支点部材４は円錐形状であっても、電極６を互いに絶縁された例えば８個のように、任意数の複数の電極に分割すれば、板形状部材２の傾斜位置での安定性に不安はあるが、上記と同じ作用をさせることができる。
【００９３】
図８９は本発明の第１９の実施形態を示す光偏向装置の主要部を説明するための平面図である。
図９０は図８９のＡ－Ａ’線断面図である。
本実施形態では、板形状部材２が単層の部材で構成される。例えば、アルミニュウムのように、それ自体反射率の高い材質を用いることによって、別途の反射手段を組み合わせることなく、目的の機能を達成することができる。
【００９４】
図９１は本発明の第２０の実施形態を説明するための図であり、図９１（ａ）は光偏向装置の上面図、図９１（ｂ）はそのＡ－Ａ’線の断面図である。なお、煩雑さを避けるため

、断面図は、切断端面のみを示す。以下すべての断面図においても同様である。以下の説明においては、これまで板形状部材と呼んでいた部材を単に板状部材と呼ぶ。また、笠形状部材は規制部材と呼ぶことにする。

【００９５】

図９１において、符号２１００は光偏向装置、符号２１０１は基板、符号２１０２は規制部材、符号２１０３は支点部材、符号２１０４は板状部材をそれぞれ示す。

基板２１０１の材質は任意でもよいが、微細化のことを考慮するとシリコンあるいはガラス等、一般に半導体プロセスや液晶プロセスにて用いられているものが望ましい。また、本発明においては後述の駆動系回路と同一基板に形成することを考慮すると（１００）面方位を有するシリコン基板が望ましい。規制部材２１０２は、一端にストッパ２１０２αを有した形状で複数配置されている。規制部材２１０２の材質としては、アレー化した時の反射領域の面積割合を最大にするために極力薄膜及び省スペースで構成でき、かつ機械的強度が強いことが望まれる。さらに、規制部材２１０２によるミラー性能の低下を抑制するために、透光性を有するシリコン酸化膜等が望まれるが、乱反射の原因になるおそれがあるときは、規制部材２１０２の表面に光吸収性の処理をしてもよい。

【００９６】

支点部材２１０３は円錐体であるが、板状部材２１０４が変位する時の支点となるので、支点となり得る形状であれば、その形は問わない。支点部材２１０３の少なくとも板状部材２１０４と接する頂部２１０３αは導電性である。支点部材２１０３の材質としては、導電性及び機械的強度を考慮すると、低抵抗な結晶シリコン膜や多結晶シリコン膜、または金属膜、またはタングステンシリサイドやチタンシリサイドなどの金属シリサイド膜、またはシリコン酸化膜やシリコン窒化膜の絶縁膜と金属膜の積層が望ましい。但し、絶縁膜と金属膜の積層の場合には板状部材２１０４へ電位を付与するために電位供給線と該金属膜を接続する接続孔が必要となる。板状部材２１０４は、固定端を有していない。板状部材２１０４は、基板２１０１と支点部材２１０３と規制部材２１０２およびストッパ２１０２αとで可動範囲が所定の空間に制限されており、後述する製造方法により形成される。板状部材２１０４は、部材全体が導電体層である。ただし、後述の静電引力を作用させる都合上、上面または裏面、あるいは部材全体、すなわち、少なくとも一部に、導電性の部材からなる導電体層を有していればよい。

【００９７】

板状部材２１０４の裏面側の少なくとも支点部材２１０３と接する接触部２１０４αは導電性である。接触部２１０４αは前述の導電体層と一体でもよいし、別体でもよい。ただし、別体の場合は双方を電気的に接続しておく必要がある。板状部材２１０４の材質としては、導電性及び機械的強度を考慮すると、アルミニウムやクロムやチタンや金や銀などの金属膜であることが望ましい。板状部材２１０４の上面２１０４ｂ全域を光反射領域にする場合には、反射性能の良好なアルミニウム系金属膜であることが好ましい。また、板状部材２１０４は前述のように可動範囲を制限されており、ほぼ支点部材２１０３を中心とした傾斜変位のみが起こるように規制部材２１０２が配置されている。さらに、板状部材２１０４は、少なくとも光反射領域２１０４ｂにおいて平板であることが望まれる。板状部材２１０４が平板であることにより光反射領域に入射した光束は反射方向をそろえて反射することが可能で、光偏向装置を画像形成装置や画像投影表示装置、あるいは、光伝送装置に用いる場合は光学的特性を維持する上で重要である。なお、板状部材２１０４の平面性としては曲率半径Ｒαが数メートル以上であることが望まれる。光反射領域２１０４ｂの光反射機能に着目するときは単に光反射面と呼ぶことがある。

【００９８】

図９２は本発明の第２１の実施形態を示す図である。図９２（ａ）は光偏向装置の上面図であり、図９２（ｂ）はＡ－Ａ’線の断面図である。

同図において、符号２１００～２１０４は第２０の実施形態と同様である。板状部材２１０４は、誘電性を有する部材からなる誘電体層２２０１と導電性を有する部材からなる導電体層２２０２の積層により構成され、かつ板状部材２１０４の少なくとも支点部材２１

０３の頂部２１０３αと接する接触部２１０４αにおいては導電体層２２０２のみにより構成されている。導電体層２２０２は、図９１における板状部材２１０４と同様な構成で良い。誘電体層２２０１は、比誘電率が３以上と高い誘電性を有することが望ましく、比誘電率が６～８と高い誘電性を示しかつ機械的強度が大きいシリコン窒化膜により構成されることが望ましい。符号２２０３は、誘電体層２２０１に形成された開口部位を示し、接触部２１０４αが頂部２１０３αと接触できるようにしている。開口部位２２０３は、写真製版技術によるパターン化で形成されている。

【００９９】

図９３は本発明の第２２の実施形態を示す図である。図９３（ａ）は光偏向装置の上面図であり、図９３（ｂ）はＢ－Ｂ’線の断面図である。

同図において、符号２１００～２１０４は第２０の実施形態と同様である。図において静電引力を作用させるための電極２３０１が基板２１０１上に４個設けられている。電極２３０１は、支点部材２１０３に構成された導電性の頂部と電気的に分離されている。電極２３０１の材質としては、第２０の実施形態と同様、後述する製造方法により作製可能であることが望ましく、導電性などを考慮すると、アルミニウム系金属や窒化チタンやチタン等の金属が望ましく、板状部材２１０４に構成された導電体層の少なくとも一部が電極２３０１と対向している。それにより基板２１０１に形成された４個の電極２３０１のいずれかに与える電位と支点部材２１０３を経由して付与された板状部材２１０４の電位との電位差に起因した静電引力を、両者の間に働かせ、板状部材２１０４を目的の方向へ変位（傾斜）させることが出来る。さらに、引き続き支点部材２１０３を中心として対向する電極２３０１の他の部分へ任意の電位を印加することにより、板状部材２１０４の変位方向を高速で変えることが出来る。さらに、４個の電極２３０１のそれぞれに与える電位を任意に切り替えることにより板状部材２１０４の傾斜の向きを２軸方向で高精度に制御することが出来る。

【０１００】

図９４は本発明の第２３の実施形態を示す図である。図９４（ａ）は光偏向装置の上面図であり、図９４（ｂ）はＢ－Ｂ’線の断面図である。

図９５は支点部材の変型例を示す図である。

図９４において、２１００～２１０２は第２０の実施形態と同様である。規制部材２１０２の配置は第２０の実施形態と異なるが基本構成は同じである。図９４には支点部材２４０１が示されている。第２２の実施形態までは、支点部材２１０３が単なる円錐体であったが、本実施形態の支点部材２４０１は、板状部材２１０４が支点部材２４０１に線状で接しており、かつ支点部材２４０１が斜面を有する尾根形状であり、したがって、板状部材２１０４は、前記接触線で規定される１軸方向のみの変位が得られる。支点部材２４０１の材質としては第１の実施例における支点部材２１０３の材質と同様である。

【０１０１】

図９５（ａ）に示すように、支点部材２４０１は鉛直断面が点を頂部とする逆Ｖ字型形状の角柱を代表とするが、図９５（ｂ）に示すように、頂部近傍が丸みを有する形状でも良い。あるいは図９５（ｃ）に示すように断面が５角形であっても差し支えない。要は、板状部材２１０４と線接触できるような稜を持った柱状体であればよい。図９４及び図９５に示すように、板状部材２１０４に接する支点部材２４０１が線状で接していることから、支点部材２４０１と板状部材２１０４の接触面積を低減して板状部材２１０４の静電引力による１軸方向の傾斜変位を安定して起こすことが出来る。支点部材２４０１が斜面を有する尾根形状であることから、支点部材２４０１の機械的強度を強めることが出来る。板状部材１２０４の変位は、基板上面における板状部材の端部との接触部位２４０２、もしくは、規制部材２１０２のストッパ２１０２αの少なくともいずれか一方で規制されるので、板状部材２１０４と他部材との接触面積を極力低減して板状部材２１０４の基板その他への固着を抑制できる。

【０１０２】

図９６は本発明の第２４の実施形態を示す図である。図９６（ａ）は光偏向装置の上面図

であり、図９６（ｂ）はＢ－Ｂ’線の断面図である。
同図において、符号２１００～２１０２及び２１０４は第２０の実施形態と同様で、符号２３０１は第２２の実施形態と同様である。符号６０１は支点部材、符号６０２は導電部材、符号６０３は絶縁性膜をそれぞれ示す。
光偏向装置２１００の支点部材６０１の斜面が、板状部材２１０４のほぼ全域に対応して形成され、かつ斜面上に静電引力を作用させるための電極２３０１を４個有する。支点部材６０１の材質としては、６０１の斜面上に電極２３０１が構成されるため、電極間を電気的に分離する目的で絶縁性であることが望ましい。その場合、板状部材２１０４に電位を付与するために支点部材６０１の頂部６０１αは導電性を有する導電部材６０２で形成することが必要である。さらに導電部材６０２は電極２３０１と同一膜により同時に形成されることが望ましい。
【０１０３】
電極２３０１全面に接触して板状部材２１０４を変位させるため、板状部材２１０４と電極２３０１間の電気的短絡を防止する目的で、第２１の実施形態に示したように板状部材２１０４の裏面に誘電体層２２０１を構成するか、もしくは、電極２３０１上に絶縁性膜６０３を構成することが必要である。絶縁性膜６０３は絶縁性を有するシリコン酸化膜、または、シリコン窒化膜であることが望ましい。さらに、絶縁性膜６０３は板状部材２１０４への電位付与を妨げないようにするために、導電部材６０２の部分にて開口していることが必要となる。図において、頂部６０１αに近づくにつれ電極２３０１を板状部材２１０４に近接して設置でき、それにより、より大きな静電引力を発生させることが出来る。言い換えると、より低電圧で板状部材２１０４の変位を可能とする。この実施例においては斜面に面接触して板状部材２１０４を変位させることが出来るので、接触時の衝撃を分散させることが出来る。斜面に面接触して板状部材２１０４を変位させることにより、板の変位方向の制御が容易となる。
【０１０４】
図９７は本発明の第２５の実施形態を示す図である。図９７（α）は光偏向装置の上面図であり、図９７（ｂ）はＢ－Ｂ’線の断面図である。
図９７において、符号２１００～２１０２及び２１０４は第２０の実施形態と同様である。符号２３０１は第２２の実施形態と同様である。符号６０１及び６０２は第２４の実施形態と同様である。符号６０４は斜面上の電極２３０１を部分的に覆う絶縁性膜を示す。絶縁性膜６０４の材質に関しては第２４の実施形態に示した絶縁性膜６０３と同様である。電極上の絶縁性膜６０４は斜面上の任意の部位において多数の凸部位７０１を有しており、凸部位７０１への板状部材２１０４の接触により光偏向方向が規定される。凸部位７０１は後述の製造方法により、絶縁性膜６０３のような絶縁性膜をパターン化して形成されることが望ましい。凸部位７０１の大きさ及び高さ及び間隔は、板状部材２１０４が弾性変形により凹部位の電極２３０１へ接触しない範囲で任意の形状として、静電引力と板状部材の剛性の関係から設計することができる。板状部材２１０４が充分に硬い材質及び厚膜の場合、板状部材は弾性変形しにくいので、凸部位７０１の大きさは出来る限り小さくし、高さも低くし、間隔は広くすることができる。それにより板状部材２１０４との接触面積を極力低減することが出来、長期にわたる駆動時の固着の可能性を低減できる。
【０１０５】
図９８は、本発明の第２６の実施形態を示す図である。
この実施形態において、符号２１００ないし２１０３は第２０の実施形態と同様である。符号２２０１～２２０３は第２１の実施形態と同様である。符号８００α、８００ｂ、８００ｃ、８００ｄは、第２２の実施形態に示した電極２３０１と同等の電極を示す。符号８０１及び８０２は支点部材２１０３の構成要素を示し、符号８０１は絶縁層、符号８０２は導電層を示す。電極８００α、８００ｂ、８００ｃ、８００ｄは、誘電体層２２０１と導電体層２２０２とからなる板状部材２１０４に対向して配置されており、材質は第２２の実施形態に示した電極２３０１の材質と同様である。支点部材２１０３の頂部２１０３αは、絶縁性のシリコン酸化膜を材質とする絶縁層８０１と導電性の導電層８０２との

積層により構成されている。導電層８０２は電極８００ａ、８００ｂ、８００ｃ、８００ｄと同時にパターン化されて形成された同一材質の部材である。

【０１０６】

図９８（ａ）は、第２６の実施形態に用いる光偏向装置２１００の上面図である。図９８（ｂ）は、初期状態の光偏向装置２１００のＡ－Ａ’線及びＢ－Ｂ’線の断面図である。図９８（ｃ－１）は、リセット動作前の光偏向装置２１００のＡ－Ａ’線上及びＣ－Ｃ’線上の断面図である。図９８（ｃ－２）は、リセット動作後の光偏向装置２１００のＡ－Ａ’線上及びＣ－Ｃ’線上の断面図である。図９８（ｄ）は一方向へ光偏向した場合の光偏向装置２１００のＡ－Ａ’線上及びＣ－Ｃ’線上の断面図である。図９８（ｅ）は、偏向軸を変えて光偏向した場合の光偏向装置２１００のＡ－Ａ’線上及びＣ－Ｃ’線上の断面図を示す。

【０１０７】

図９８（ｂ）において、初期の光偏向装置２１００は、板状部材２１０４が固定端を有していないので、その位置は所定空間内では自由である。そこで、図９８（ｂ）においては、電極から最も遠ざかる配置を記載した。この図のように、板状部材２１０４が基板２１０１上のすべての電極から等距離にあるとき、板状部材２１０４と頂部２１０３ａとの接触の有無にかかわらず、板状部材２１０４は中立位置にあると呼ぶことにする。図９８（ｃ－１）には、板状部材２１０４が支点部材２１０３に接触前を示してある。また、図９８（ｃ－２）には、板状部材２１０４が支点部材２１０３に接触後を示してある。初期状態から、板状部材２１０４を支点部材２１０３に接触させるために、図９８（ｃ－１）及び図９８（ｃ－２）におけるリセット動作を行う。

【０１０８】

リセット動作においては、電極８００ａ、８００ｂの電位をＸ（Ｖ）とし、電極８００ｃ、８００ｄ　、導電層８０２の電位を０（Ｖ）とする。図９８（ｃ－１）の支点部材２１０３に板状部材２１０４が接触する前は板状部材が電気的に浮いている状態なので、図９８（ｃ－１）における下向きの白抜き矢印で示したような静電引力分布が得られる。以降、白抜き矢印の大きさにより静電引力の大小を模式的に示す。すなわち、電気的に浮いている板状部材２１０４を経由して電極８００ａ、８００ｂと電極８００ｃ、８００ｄ間に静電引力が作用し、板状部材２１０４が基板２１０１表面に垂直に引き寄せられる。その後、図９８（ｃ－２）の支点部材２１０３に板状部材２１０４が接触した後は、板状部材２１０４の電位が支点部材２１０３の電位と等しくなるため、板状部材２１０４と電極８００ｃ、８００ｄの間には反発力は作用しても静電引力は作用せず、板状部材２１０４と電極８００ａ、８００ｂの間には強い静電引力が作用する。そのため板状部材２１０４が電極８００ａ、８００ｂのある側に傾斜し、板状部材２１０４の端部２１０４ｃが基板２１０１と接触して方向を規制されて、特定の方向に反射光が得られる。この状態をリセット状態とし、このときの反射光の方向をリセット方向と呼ぶ。

【０１０９】

ここで印加される電位Ｘ（Ｖ）は、板状部材２１０４と電極との距離及び静電容量などにより決定され、通常の板状部材２１０４の変位、すなわち、支点部材２１０３を中心とした傾斜をひき起こす限界の電圧Ｘ（Ｖ）よりやや大きい電圧とする。この電圧（実際には後述のように電位差）をこの実施例における所定の電位差と呼ぶ。次に図９８（ｄ）において、電極８００ａ、８００ｂの電位を０（Ｖ）、　電極８００ｃ、８００ｄの電位をＸ（Ｖ）に切り替えることにより、リセット方向と反対方向に高速に板状部材２１０４が傾斜変位し、板状部材２１０４の端部２１０４ｄが基板２１０１と接触して方向を規制されて、図のように”光偏向１”の状態になる。

【０１１０】

それぞれの電極及び導電層に、正負の極性にかかわらず、同じ値のバイアス電圧を加算しても、各部位の間の電位差が同じなので動作は変わらない。すなわち、静電引力は、電位そのもので発生するのではなく、対向する部材の間に存在する電位差で発生するものである。なお、この例では支点部材２１０３の導電層８０２には０（Ｖ）の電位を与えたまま

にして、電極側の電位を切り替えているが、板状部材２１０４の変位を単にリセット方向と反対方向に切り替えるだけなら、電位の与え方を逆の関係にしても同じ動作が得られる。すなわち、電極８００ａ、８００ｂにはＸ（Ｖ）の電位を、電極８００ｃ、８００ｄには０（Ｖ）の電位を与えたままにしておき、導電層８０２にリセット時は０（Ｖ）の電位を与えて、"光偏向１"の状態への動作時にはＸ（Ｖ）の電位に切り替えるようにしてもよい。板状部材２１０４は、電極との間に電位差のある側、もしくは電位差のより大きい側に強い静電引力を受けてその方向に傾斜する。すなわち、支点部材２１０３を中心として対向する電極へ任意の電位を印加し、導電層８０２の電位をいずれかの電極の電位と等しくすることにより、板状部材２１０４の変位方向を高速で変えることが出来る。これらのことは以後の実施例においても同様のことがいえる。

【０１１１】

次に図９８（ｅ）において、電極８００ａ、８００ｃ及び支点部材８０２の電位を０（Ｖ）、電極８００ｂ、８００ｄの電位をＸ（Ｖ）とすることにより、図９８（ｄ）の光偏向とは軸を変えて、高速に板状部材２１０４が傾斜変位し、板状部材２１０４の端部２１０４ｅが基板２１０１と接触して方向を規制されて、「光偏向２」の状態になる。この軸方向においても、上記のように電極、あるいは、導電層に与える電位を切り替えることで、板状部材２１０４を逆方向に反転傾斜させ、「光偏向３」の状態にさせることができる。したがって、板状部材２１０４は初期位置以外に３つの態位をとることができる。すなわち、板状部材２１０４の傾斜の向きを２軸方向で高精度に制御することが出来る。以上のように、複数の電極に異なる電位を与えることにより、板状部材２１０４が静電引力により変位し、すなわち、支点を中心に傾斜し、入射する光束の反射方向を初期位置も含めて合計４方向に変えることが出来る。

【０１１２】

次に、図９８（ｃ－１）のリセット動作時のように電気的に浮いている板状部材２１０４を、異なる電極８００ａ、８００ｂ、８００ｃ、８００ｄ及び導電層８０２に異なる電位を与えることにより静電引力を発生させて変位させる原理を、図９９に簡単に説明する。なお、図９９における説明では、板状部材２１０４上に導電体層２２０２を配置した効果も含めて記載する。

【０１１３】

図９９は、図９８における光偏向装置２１００の、リセット動作時のＤ－Ｄ'線の断面図である。

同図において、電極８００ｂには正電位Ｘ（Ｖ）が印加され、電極８００ｄには０（Ｖ）が印加されている。この時両電極８００ｂ、８００ｄと電気的に浮いている板状部材２１０４の間には静電引力が発生し、板状部材２１０４を電極側に変位させるのであるが、まず電極８００ｂに印加された正電位により電極８００ｂには正電荷が現れる。そして空隙９０１を介して誘電体層２２０１に誘電的に負電荷が発生し、同時に導電体層２２０２において導電的に効率よく負電荷が広がる。逆に言うと、導電体層２２０２により効率的に誘電体層２２０１に負電荷を発生させる。

【０１１４】

この時、誘電体層２２０１と導電体層２２０２は電気的に浮いているので、電極８００ｄに空隙９０１を介して対向する誘電体層２２０１と導電体層２２０２には模式的には正電荷が広がる。その正電荷に対応するように、電極８００ｄには模式的に負電荷が発生する。電極８００ｄは実際には０（Ｖ）であるが、模式的に考えた場合はそのようになる。それにより電極８００ｄ上部に位置する板状部材においても静電引力が発生する。上記説明は一連の流れにて説明したが、必ずしも一連の流れにより起こる訳ではなく、電極８００ｂと８００ｄの電位差がそれらの現象を同時進行的に発生させる。実際には、電気的に浮いている誘電体層２２０１と導電体層２２０２は電極８００ｂと電極８００ｄの間の特定の電位となり、該特定の電位と電極８００ｂの電位差による静電引力及び該特定の電位と電極８００ｄの電位差による静電引力が発生することとなる。この特定の電位は空隙９０１及び電極８００ｂ、８００ｄの面積などの構造的要因により定まる。このようにして発

生した静電引力により板状部材２１０４が電極側に傾斜変位する。

【０１１５】

図１００は、本発明の第８の実施例を示す図である。

図１００（ａ）は、図９８（ａ）同様、第２６の実施形態に示したものと同じ光偏向装置２１００の上面図である。図１００（ｂ）は、図９８（ｂ）同様、初期状態の光偏向装置２１００のＡ－Ａ'線及びＢ－Ｂ'線の断面図である。図１００（ｃ－１）及び図１００（ｃ－２）は、図９８（ｃ－１）及び図９８（ｃ－２）同様、それぞれリセット動作前と後の光偏向装置２１００のＡ－Ａ'線上及びＣ－Ｃ'線上の断面図である。図１００（ｄ）は、一方向へ光偏向した場合の光偏向装置２１００のＡ－Ａ'線上及びＣ－Ｃ'線上の断面図である。図１００（ｅ）は、偏向軸を変えて光偏向した場合の光偏向装置２１００のＡ－Ａ'線上及びＣ－Ｃ'線上の断面図である。

【０１１６】

図１００（ｂ）の初期状態及び図１００（ｃ－１）、図１００（ｃ－２）のリセット動作は図９８と似ているが電位の与え方は異ならせてある。電極８００ａの電位をＹ（Ｖ）、電極８００ｃ、８００ｄ、及び、導電層８０２の電位を略Ｙ／２　（Ｖ）、電極８００ｂの電位を０（Ｖ）とする。板状部材２１０４が支点部材２１０３に接触していない場合でも、図９８で説明したリセット動作とほぼ同様の現象により、板状部材２１０４は支点部材２１０３に接触し、導電層８０２から略Ｙ／２　（Ｖ）の電位が与えられる。

電極８００ｃ、８００ｄは板状部材と同じ電位が与えられているので両者の間のは静電引力は働かない。電極８００ｂと板状部材、および、板状部材２１０４と電極８００ａの間の電位差はともに略Ｙ／２　（Ｖ）となり、電極と板状部材との間に強い静電引力が働き、板状部材２１０４は電極８００ａ、８００ｂのある側に傾斜する。この状態をリセット状態とする。

【０１１７】

図１００（ｄ）において、電極８００ｃの電位をＹ（Ｖ）、電極８００ａ、８００ｂ、及び、導電層８０２の電位を略Ｙ／２　（Ｖ）、電極８００ｄの電位を０（Ｖ）とすることにより、リセット方向と反対方向に高速に板状部材２１０４が傾斜変位し、板状部材２１０４の端部２１０４ｄが基板２１０１と接触して方向を規制されて、"光偏向１"の状態になる。それぞれの電極及び導電層に、正負の極性にかかわりなく、一定値のバイアス電位を加算しても動作は全く同じである。すなわち隣接する２つの電極へ大小異なる任意の電位を印加し、残りの２つの電極と導電層８０２には前記大小の電位の中間の電位を与えることにより、板状部材２１０４の変位方向を高速で変えることが出来る。ここで印加される電位Ｙ（Ｖ）は、所定値のことであり、次の条件で定める。すなわち、導電層８０２に与える電位Ｙ／２（Ｖ）が板状部材２１０４の変位を引き起こす限界の電圧Ｚ（Ｖ）よりやや大きい電位となるように設定する。

【０１１８】

次に図１００（ｅ）において、電極８００ｂの電位をＹ（Ｖ）、電極８００ａ、８００ｃ、及び、導電層８０２の電位を略Ｙ／２（Ｖ）、８００ｄの電位を０（Ｖ）とすることにより、図１００（ｄ）の光偏向とは軸を変えて、高速に板状部材２１０４が傾斜変位し、板状部材２１０４の端部２１０４ｅが基板２１０１と接触して方向を規制されて、「光偏向２」の状態となる。すなわち、板状部材の傾斜の向きを２軸方向で高精度に制御することが出来る。以上のように、複数の電極間に異なる電位を与えることにより、板状部材２１０４が静電引力により支点を中心に傾斜し、入射する光束の反射方向を変えることが出来る。以下に、光偏向のための静電引力の作用を、図１００（ｄ）を例に簡単に述べると、支点部材８０２を略Ｙ／２（Ｖ）とすることにより板状部材の電位も略Ｙ／２（Ｖ）となる。そのため、電極８００ａ、８００ｂに対向する部位においては同電位なので静電引力はほぼ作用しない。それに対し、電極８００ｃ、８００ｄに対向する部位においては電位差が略Ｙ／２（Ｖ）生じるので、それぞれほぼ同等の静電引力　すなわち略Ｙ／２（Ｖ）の電位差に対応する静電引力が作用し、板状部材が"光偏向１"方向へ傾斜する。図１００（ｅ）においても、軸が異なるが同様に、板状部材が"光偏向２"方向へ傾斜する。

本実施例では、最大電位を与える電極と最小電位を与える電極とが、板状部材の変位の軸となる、支点部材の頂部を通る直線に関して同じ側に存在していることが条件である。電極数が４個の場合は隣接する電極が条件になる。

【０１１９】

次にこの実施例の光偏向方式の利点を、図１００（ｄ）を例に説明する。図１００（ｄ）において、電極８００ｃ、８００ｄにはそれぞれＹ（Ｖ）、０（Ｖ）が印加されているので、仮に板状部材２１０４が傾斜変位の過程で支点部材２１０３から離れ、板状部材２１０４が電気的に浮いた状態となっても、図９９に記載のように電極８００ｃ、８００ｄに対向する板状部材には静電引力を発生させることが出来る。それにより、目的方向への光偏向を達成できる。すなわち、利点として安定した光偏向を可能とすることが出来る。特に、光偏向装置の使い方が図とは上下が逆であった場合において、この効果は顕著に出る。すなわち、このような使い方の場合は、装置に何も電位が印加されていない場合は、常に板状部材２１０４が支点部材２１０３から離れた状態になっているからである。

さらに、他の利点は、後述の第２９の実施例と組み合わせることによって得られる。

【０１２０】

次に、図１００（ｆ）を用いて、第２７の実施形態の変形実施形態を説明する。電極８００ａの電位をＸ（Ｖ）、電極８００ｂ、８００ｃの電位を略Ｘ／２（Ｖ）、電極８００ｄの電位を０（Ｖ）とし、導電層８０２の電位を０（Ｖ）とする。ここで示す電位Ｘ（Ｖ）は、第２６の実施形態で説明したものと同じである。

板状部材２１０４は、電極８００ａとの間に大きな電位差があるため強い静電引力が働き、電極８００ｂ、８００ｃとの間には小さい電位差があるため弱い静電引力が働き、電極８００ｄとの間には電位差がないため静電引力が働かない。したがって、板状部材２１０４は図１００（ｆ）のように電極８００ａの方向に傾斜し、板状部材２１０４の対角線上の端点２１０４ｆにおいて基板２１０１と接する。すなわち、図１００（ｄ）、図１００（ｅ）に示す変位方向は、いずれもほぼ正方形で示す板状部材２１０４の辺の方向への傾斜であったが、変形実施形態で得られる傾斜方向は板状部材２１０４の対角線方向への傾斜である。この実施形態でも、電極への電位の与え方で４通りの傾斜方向が得られる。

【０１２１】

実施形態２７と変型実施形態は同じ構成で、印加電位の組み合わせ方を変えているだけなので、制御次第で光の反射方向を合計８方向に切り替えることができる。第２６の実施形態と変型実施形態を組み合わせた制御を行っても同様の効果が得られる。電極８００ｂ、８００ｃに与える略Ｘ／２（Ｖ）という電位は電位０（Ｖ）の板状部材２１０４との間で弱い静電引力を発生させるので、板状部材２１０４の剛性が小さい場合はたわみが発生するおそれもある。そのような構成の場合は、電極８００ｂ、８００ｃに与える電位を小さくするか、導電層８０２と同電位の０（Ｖ）としてもよいし、あるいは、電源から切り離して、電気的に浮いた状態にしてもよい。電極８００ｂ、８００ｃに与える電位を、略Ｘ／２（Ｖ）とするか、電気的に浮いた状態にした場合は、導電層８０２に与える電位を０（Ｖ）からＸ（Ｖ）に切り換えるだけで板状部材２１０４の傾斜方向を逆側の電極８００ｄ側に反転させることができる。以上述べた各例から分かるように、板状部材２１０４の光反射面の法線を傾けたい場合、その方向にある電極と、板状部材２１０４との間の電位差が最大になるように与えることが基本である。このときの電極数は１個の場合と２個の場合があるのは既述の通りである。板状電極２１０４と隣り合う２個の電極との間に、同時に所定の電位差を与える場合は板状電極２１０４が辺の方向へ傾斜し、１個の電極との間に所定の電位差を与えれば、対角線方向へ傾斜する。

【０１２２】

次に、光偏向装置２１００の形状について述べる。これまでの説明では理解を容易にするために、板状部材がほぼ正方形である場合について説明してきたが、本発明の構成はこれに限定されるものではない。また、基板上の電極の数も最大４個までで説明してきたが、これも４個に限定されるものではない。

図１０１は、本発明の第２８の実施形態を説明する図である。図１０１において、外形そ

の他が円形に構成されているが、符号２１００ないし２１０４は第１の実施例と同様である。ただし、支点部材２１０３は板状部材の直径より小さめの底面を有する円錐体状に示されている。符号８００ａないし８００ｈは、円錐体状の支点部材２１０３の側面に分割して設けられた８個の電極であり、各電極は相互に絶縁されている。

【０１２３】

電極８００ａの電位をＸ（Ｖ）、電極８００ｅの電位を０（Ｖ）とし、その他の電極をたとえば電気的に浮いた状態にしておく。支点部材２１０３の導電層８０２に仮に０（Ｖ）の電位を与えると、板状部材２１０４は電極８００ａとの間の大きな電位差により、電極８００ａの方向に傾斜する。また、導電層８０２に仮にＸ（Ｖ）の電位を与えると、板状部材２１０４は逆に電極８００ｅの方向に傾斜する。このようにして、電極及び導電層に与える電位の組合せで、板状部材２１０４は、電極のあるすべての方向に傾斜させることが可能になる。したがって、光の反射方向として８方向を選択的に設定することができる。上記説明では支点部材２１０３を円錐体として説明したが、正８角錐体にしても構わない。第２３の実施形態と類似の考え方で、動作時に板状部材２１０４を支点部材の斜面に沿わせるように構成する場合は、円錐体の側面より角錐体の側面の方が傾斜方向の設定が安定する。本実施例では８個の電極で説明したが、その個数は角錐体が作れる範囲で全く自由である。すなわち、第２３の実施形態に用いた柱状体の代わりに、上記に示した角錐体を、板状部材のほぼ全域に対応して斜面を有するように設置し、各斜面には互いに絶縁された電極を斜面の数だけ設ければ、任意の数の偏向方向を有する安定した光偏向装置が得られる。

【０１２４】

第２７の実施形態における電位の与え方は、最大電位を与える電極と最小電位を与える電極とが、板状部材の変位の軸となる支点部材の頂部を通る直線に関して同じ側に存在していることが条件であると述べた。電極数が４個の場合は隣接する電極であることが必須であるが、電極数が６個以上の場合は必ずしも隣接している必要がなくなる。すなわち、最大電位を与える電極と最小電位を与える電極との間に、他の電極が１個以上入っていても構わない。電極数が６個の場合は１個しか間に入り得ないが、電極数が８個の場合は、最大２個まで間に入り得る。このように電位を与えると、板状部材の変位は力関係により、電位差を与えた両電極の中間に向けて傾斜する。間に挟まっている電極数が奇数、すなわち、１個もしくは３個なら、板状部材は中間の電極の斜面に接触して安定する。したがって、この、間に挟まった電極には電位を与えないで電気的に浮いた状態にしておけば、最大の電位差が隣接同士の電極にかかることがなく、放電や、短絡のおそれがなく安定した動作が期待できる。

【０１２５】

図１０２は本発明の第２９の実施形態を説明する図である。この実施形態では、光偏向装置２１００を任意の基板上にアレー状に並べて光偏向アレー１２００とした。図１０２（ａ）は上面図であり、１０２（ｂ）はＡ－Ａ'線の断面図である。図では、１次元に並べた状態を示しているが、２次元に並べても構わない。光偏向装置２１００を集積化することにより、光偏向装置２１００を同時にかつ独立に駆動制御して光偏向させることができる。このように集積化してアレー状に並べたときの個別の光偏向装置２１００を便宜上"素子"と呼ぶことがある。

【０１２６】

次に、第３０の実施形態を説明する。この実施形態における光偏向装置は、第２０ないし第２９の実施形態における光偏向装置２１００の板状部材２１０４の近傍の雰囲気がほぼ真空である。真空状態を形成する方法としては、光偏向装置２１００をパッケージ化する際に、真空封止することにより達成可能である。図１０２にほぼ真空状態とする利点を図９８に示す光偏向装置２１００を複数１次元アレー化した実施例３０の場合を例として説明する。前述のように、図１０２の光偏向アレー１２００の各素子において、２１０１及び２１０２は図９１と同様である。２２０１～２２０３は図９２と同様である。８００ａ、８００ｂ、８００ｃ、８００ｄ及び８０１、８０２は図９８と同様である。図１０２（

a）は、実施形態３０の光偏向アレー１２００の上面図である。図１０２（ｂ）は、各素子が任意の光偏向を行っている場合の光偏向アレー１２００のＡ－Ａ'線の断面図である。

【０１２７】

図１０２（ｂ）は板状部材２１０４の近傍の雰囲気が通常の大気である場合を模式的に示している。一つの素子（左端の素子）の板状部材２１０４が傾斜変位したことにより板状部材２１０４直下の大気が圧力を受け、隣接する素子（中央の素子）へ浮力を及ぼすことになる。それにより、隣接する素子は白抜き矢印で示した目的の方向への変位を妨げられることになる。板状部材２１０４の近傍の雰囲気をほぼ真空にすることにより、光偏向アレー１２００においては、上記浮力の影響を抑制することができる。単体の光偏光装置においては、空気中の　などが入らないように装置周囲をカバーで覆うようにパッケージ化した場合、電圧印加による板状部材２１０４の急速な傾斜の変化に対して雰囲気の気体が粘性抵抗となり、わずかな応答遅れが生ずることを防ぐことができる。

【０１２８】

次に、第３１の実施形態を説明する。この実施形態の光偏向装置２１００は、板状部材２１０４の近傍の雰囲気が不活性な気体である。不活性な気体としては、窒素、アルゴン、ヘリウム、ネオンなどがあり、その中では比較的安価であり安全な窒素が望ましい。不活性な気体雰囲気を形成する方法としては、光偏向装置２１００をパッケージ化する際に、不活性気体中において封止することにより達成可能である。板状部材の近傍の雰囲気を該不活性な気体とする利点は、雰囲気中の水分を低減することができ、それにより、板状部材が傾斜変位し基板へ接触した時の接触点及び支点部材と板状部材の接触点における固着を抑制できることである。ただし、封入気体が板状部材２１０４の変位に対して粘性抵抗となるおそれがあれば、なるべく低圧にして封入することが望ましい。

【０１２９】

画像投影表示装置に本発明を適用した実施例を、図１０３を用いて説明する。図１０３は本発明の光偏向アレー１２００を、画像投影表示装置に適用した例を説明する図である。同図において、符号１３００は画像投影表示装置、符号１３０１は光スイッチ手段、符号１３０２は光源、符号１３０３はレンズ、符号１３０４は絞り、符号１３０５は回転カラーホール、符号１３０６はマイクロレンズアレー、符号１３１０は投影スクリーンをそれぞれ示す。

光偏向装置２１００または光偏向アレー１２００のいずれも、画像投影データの表示（すなわち画素の明暗表示）装置の光スイッチ手段として用いることができる。したがって、画素の明暗制御（すなわち光スイッチのＯＮ／ＯＦＦ制御）が良好で、迷光（反射方向が乱れた時に発生する隣接素子からの反射光）を抑制でき、高速な動作が可能で、長期的な信頼性が高く、低電圧で駆動でき、かつコントラスト比を向上できる。この実施例では光偏向アレー１２００を用いている。

【０１３０】

画像を投影して表示する画像投影表示装置１３００は、投影画像データの入射光束（Ｒ）の反射方向を変えて光偏向を行なって画像を投影する光偏向アレー１２００からなる光スイッチ手段１３０１が画像を投影スクリーン１３１０に投影して表示するようになっている。上記光スイッチ手段１３０１は、光源１３０２からの入射光束（Ｒ）が光偏向アレー１２００に照射され、光偏向アレー１２００内の各素子の板状部材２１０４の光反射面により反射し、投影レンズ１３０３、及び、絞り１３０４を介して上記投影スクリーン１３１０に投影する。カラー表示を行うためには、上記光源１３０２の前に回転カラーホール１３０５を設けてもよい。性能向上のためにマイクロレンズアレー１３０６を用いることも出来る。したがって、入射光の反射方向を変えて光偏向を行う、構造が簡単で応答も速く、使用する入射光（Ｒ）の波長が制限されることなく、駆動電圧が低く作動が安定で信頼性も高く、製造工程が少なく低コストの光偏向アレー１２００を具備する画像投影表示装置１３００を提供することが出来るようになった。

【０１３１】

次に、画像投影表示装置における光偏向アレー１２００の好ましい配置の仕方について説明する。すなわち、光偏向アレー１２００の各素子の、板状部材２１０４の中立位置における光反射面の法線方向が重力の作用方向とほぼ同方向になるように配置する。本発明の光偏向アレー１２００を画像投影表示装置に用いる場合、このように配置することにより、基板表面２１０１に形成された支点部材に板状部材２１０４が接触する場合に板状部材２１０４に重力が作用するので、どの電極の方向への板状部材２１０４の傾斜も、重力が均等に作用し、偏りがない。それにより、板状部材２１０４が傾斜変位する場合にさらに安定した動作、すなわち、長期信頼性や繰り返し再現性のある動作を得ることが出来る。本発明の光偏向装置２１００は偏向ミラーに相当する板状部材が固定端を有していないので、より効果的である。なお、図１０３は一般的な使い方を説明する図であるため、光偏向アレー１２００の各素子の板状部材２１０４の中立位置の向きについて特定の方向を示していないが、この配置を採用する場合は、必要に応じて、中間に反射鏡などを使えば目的を達成することができる。また、光偏向アレーの代わりに光偏向装置を用いる場合でも、同様に上記配置は有効である。

【０１３２】

画像形成装置に本発明を適用した実施例を、図１０４を用いて説明する。

図１０４は、本発明の光偏向アレー１２００を複写機等の画像形成装置に適用した例を示す図である。図において、画像形成装置１４００　は、主な機能ブロックとして、ドラム形状の感光体の画像担持体１４０１と、潜像形成手段１４０２と、現像手段１４０３と、転写手段１４０４と、帯電手段１４０５と、定着手段１４０６と、排紙トレイ１４０７と、クリーニング手段１４０８とからなる。本実施例は、光偏向アレー１２００を潜像形成手段１４０２に組み込むことから、光書込み時のＯＮ／ＯＦＦ制御が良好で、迷光（反射方向が乱れた時に発生する隣接素子からの反射光）を抑制でき、高速な動作が可能で、長期的な信頼性が高く、低電圧で駆動でき、かつＳ／Ｎ比を向上できる。

【０１３３】

潜像形成手段１４０２以外は周知の画像形成手段であるので、それらについての詳細な説明は省略する。画像担持体１４０１は図示の矢印Ｄ方向に回転可能に保持されて形成画像を担持する。潜像形成手段１４０２は本発明の光偏向アレー１２００をライン露光型の露光手段として用いる。

帯電手段１４０５で均一に帯電された感光体上に、潜像形成手段１４０２で光書き込みが行なわれて潜像が形成される。すなわち、入力された画像データに対応して光偏向アレー１２００の各素子のスイッチングが行われ、形成された潜像は現像手段１４０３で顕像化されトナー画像が形成され、形成されたトナー画像は転写手段１４０４で被転写体（Ｐ）に転写されて、定着手段１４０６で定着された後に、被転写体（Ｐ）は排紙トレイ１４０７に排紙されて収納される。他方、トナー画像を上記転写手段１４０４で被転写体（Ｐ）に転写した後の上記画像担持体１４０１のドラム形状の感光体は、クリーニング手段１４０８でクリーニングされて次工程の画像形成に備えるようになっている。

【０１３４】

上記潜像形成手段１４０２は、光源１４０２ａからの入射光束（Ｒ）を、第１のレンズシステム１４０２ｂを介してアレー状に複数個配置された素子に照射し、各素子は画像情報に応じて、反射手段としての光偏向アレー１２００を経て入射光束（Ｒ）を第２のレンズシステム１４０２ｃを通して画像担持体１４０１のドラム形状の感光体上の表面に結像させるようになっている。従って、入射光の反射方向を変える光偏向の構造が簡単で応答も速く、使用する入射光の波長が制限されることなく、駆動電圧が低く、作動が安定で信頼性も高く、製造工程が少なく低コストの光偏向アレー１２００を具備する画像形成装置１４００を提供することが出来るようになった。

【０１３５】

光伝送装置に本発明を適用した実施例を、図１０５を用いて説明する。

図１０５は２次元的に配列された本発明の光偏向アレー１２００を光伝送装置に適用した例を示す図である。

図１０５（ａ）は複数のポートから複数のポートへの光電送の例、図１０５（ｂ）は単数のポートから複数のポートへの光電送の例を示す図である。
図１０５（ａ）において、光伝送装置１５００は、基本構成として、光信号入力部１５０２と、１段目の光偏向アレー１５０３と、その制御装置１５０４と、２段目の光偏向アレー１５０５と、その制御装置１５０６と、光信号出力部１５０７と、信号伝達ポート１５０８とを有する。
図１０５（ａ）において、光偏向アレー１２００を、入力光情報信号の反射方向を変えて出力光情報信号のポートを決定する光スイッチ手段として用いることから、２軸方向の光偏向を容易に正確に行うことが出来、それによりポートの選択の制御が良好で、隣接ポートへの迷光を抑制でき、高速な光路切り替えが可能で、長期的な信頼性が高く、低電圧で駆動でき、かつ同一基板上に集積化できる。
【０１３６】
光情報信号が複数の信号伝達ポート１５０８を有する光信号入力部１５０２から本発明の光伝送装置１５０１に入力され、それが２段の光偏向アレー１５０３及び１５０５により２軸方向に偏向され、出力ポートを選択して複数の信号伝達ポート１５０８を有する光信号出力部１５０７から出力される。本実施例においては、光偏向角を大きく取るために１段目の光偏向アレー１５０３及び２段目の光偏向アレー１５０５の２段としたが、選択するポートの数によっては、光偏向アレーは１個でも良い。光偏向アレー１５０３及び１５０５は、それぞれの光偏向アレー内の各素子を同時にかつ独立して駆動制御するための制御装置１５０４及び１５０６をそれぞれ具備している。なお、これまでの説明では分かりやすくするため、信号入力部と信号出力部、あるいは、入力ポートと出力ポートは相異なるものとして説明してきたが、光伝送は、通常、双方向伝送が可能なので、実際は"信号入出力部"、あるいは、"入出力ポート"として、信号入力部と信号出力部、あるいは、入力ポートと出力ポートを区別する必要はない。
【０１３７】
光伝送装置の他の実施例を図１０５（ｂ）を用いて説明する。この実施例の構成は、１個の入出力ポート１５１１を有し、単体の光偏向装置２１００と、光偏向装置２１００の選択可能な反射光の方向の数だけの入出力ポート１５１４のみを有した信号入出力部１５１３を有している。図は実施形態２６に示す光偏向装置２１００を用いる場合を示しているが、この実施形態では、選択可能な反射光の方向は４方向あるので、一方の入出力ポートとして１個であっても、他方の入出力ポートとしては４個まで設定し得る。図の光路を示す実線は、光偏向装置２１００によって１つの入出力ポート１５１４が選択されている場合を示し、破線は他の入出力ポートに切り換えられた場合を示す。図では反射鏡１５１２を介して入出力ポート１５１１と光偏向装置２１００とを光学的に接続しているが、反射鏡をやめて、入出力ポート１５１１を信号入出力部１５１３の中心部に配置することもでき、構造的には非常に簡単になる。さらに、このような組み合わせの入出力ポートのセットを複数セット一体化して用いることもできる。
【０１３８】
次に、光偏向装置の製造方法について説明する。
図１０６は光偏向装置２１００または光偏向アレーの製造工程を示す図である。
図１０６（ａ）～（ｈ）に、第２６の実施形態に示す光偏向装置２１００を例に取り、代表的な工程に沿って示した。図１０６（ａ）～（ｈ）は同実施形態におけるＢ－Ｂ'線上の断面概略図である。
シリコン基板上に複数の区画を形成する。区画の並べ方は１次元でも２次元でもよい。単体の光偏向装置を得る目的であれば、各区画の間に切り離しのためのマージンを設けておく。光偏向アレーを得る目的であれば、各区画は密着させて形成する。
【０１３９】
図１０６（ａ）：シリコン基板２１０１上に、支点部材の誘電層８０１を構成するシリコン酸化膜１６０１がプラズマＣＶＤ法により堆積され、
その後、面積階調を有するパターンを形成したフォトマスクを用いた写真製版法やレジス

トパターン形成後熱変形させる写真製版法により、支点部材の形状とほぼ同形状の任意の膜厚を有するレジストパターンを形成し、その後、ドライエッチング法の手法により目的形状の誘電層８０１が形成される。

図１０６（ｂ）：電極８００ｂ、８００ｄ及び支点部材の導電層８０２を窒化チタン（ＴｉＮ）膜の薄膜で形成する。図に見えない電極８００ａ、８００ｃもこのとき同時に形成される。

ＴｉＮ薄膜は、Ｔｉをターゲットとしたｄｃマグネトロンスパッタ法により成膜し、写真製版法及びドライエッチング法の手法により複数の電極としてパターン化した。

【０１４０】

図１０６（ｃ）：非晶質のシリコン膜をスパッタ法により堆積させ、ＣＭＰ技術を用いて処理時間制御にて平坦化した。

残存する非晶質シリコン膜が第１の犠牲層１６０２である。なお、犠牲層としては上記膜以外にもポリイミド膜や感光性有機膜（一般的に半導体プロセスにて用いられるレジスト膜）や多結晶シリコン膜などを用いることも出来、平坦化の手法としては、熱処理によるリフロー法やドライエッチングによるエッチバック法を用いることも出来る。

図１０６（ｄ）：板状部材の誘電体層２２０１としてシリコン窒化膜をプラズマＣＶＤ法により堆積させ、写真製版法及びドライエッチング法の手法によりパターン化し、開口部２２０３及び誘電体層２２０１を形成した。引き続き光反射領域を兼ねる導電体層２２０２となるアルミニウム系金属膜をスパッタリング技術により堆積させ、写真製版法及びドライエッチング法によりパターン化した。

【０１４１】

図１０６（ｅ）：非晶質なシリコン膜をスパッタ法により堆積させ、第２の犠牲層１６０３とした。やはり犠牲層としては上記シリコン膜以外にもポリイミド膜や感光性有機膜（一般的に半導体プロセスにて用いられるレジスト膜）や多結晶シリコン膜などを用いることも出来る。第２の犠牲層１６０３は第１の犠牲層１６０２と同じ材質であることが望まれる。

図１０６（ｆ）：光偏向装置２１００を個別に分離し、板状部材の周囲に規制部材２１０２を配置するために、写真製版法及びドライエッチング法により、第１の犠牲層１６０２及び第２の犠牲層１６０３を同時に板状部材よりやや広くパターン化した。

図１０６（ｇ）：規制部材２１０２を構成するシリコン酸化膜をプラズマＣＶＤ法により堆積させ、写真製版法及びドライエッチング法により任意の箇所にパターン化し規制部材２１０２とした。

図１０６（ｈ）：残存する第１の犠牲層１６０２及び第２の犠牲層１６０３を、テトラメチルアンモニウムヒドロキシド（ＴＭＡＨ）液によるウェットエッチング技術により、規制部材２１０２近傍の開口部を通してエッチング除去し、板状部材２１０４を可動範囲が制限された空間に配置して、本発明の光偏向装置が完成する。

【０１４２】

次に、第２５の実施例における光偏向装置の製造方法について説明する。この製造方法は、光偏向装置２１００の製造方法の一部の工程であり、少なくとも、複数の電極上に誘電性薄膜を堆積させる工程を有し、その薄膜をパターン化し凸部位を形成する工程を有する。

図１０７は光偏向装置２１００の支点部材の斜面の凸部位を形成する工程を示す図である。

図１０７（ａ）～（ｉ）に、代表的な工程にを示した。図１０７（ａ）～（ｉ）はＢ－Ｂ'線上の断面概略図である。

【０１４３】

図１０７（ａ）：シリコン基板２１０１上に、支点部材を構成するシリコン酸化膜がプラズマＣＶＤ法により堆積され、その後、面積階調を有するパターンを形成したフォトマスクを用いた写真製版法やレジストパターン形成後熱変形させる写真製版法により、支点部材の形状とほぼ同形状の任意の膜厚を有するレジストパターンを形成し、その後、ドライ

エッチング法の手法により目的形状の支点部材６０１が形成される。
図１０７（ｂ）：電極２３０１及び支点部材の導電性を有する部材６０２を窒化チタン（ＴｉＮ）膜の薄膜で形成する。
ＴｉＮ薄膜は、Ｔｉをターゲットとしたｄｃマグネトロンスパッタ法により成膜し、写真製版法及びドライエッチング法の手法により複数の電極としてパターン化した。
【０１４４】
図１０７（ｃ）：板状部材と電極の電気的短絡を防止するための絶縁膜６０３としてシリコン酸化膜がプラズマＣＶＤ法により堆積され、その後写真製版法及びドライエッチング法の手法により目的形状の凸部位７０１が任意の箇所にパターン化される。なお、この時同時に板状部材の電位を付与するために支点部材の頂部近傍が開口される。
図１０７（ｄ）：非晶質のシリコン膜をスパッタ法により堆積させ、ＣＭＰ技術を用いて処理時間制御にて平坦化した。
残存する非晶質シリコン膜が第１の犠牲層１７０２である。なお、犠牲層としては上記膜以外にもポリイミド膜や感光性有機膜（一般的に半導体プロセスにて用いられるレジスト膜）や多結晶シリコン膜などを用いることも出来、平坦化の手法としては、熱処理によるリフロー法やドライエッチングによるエッチバック法を用いることも出来る。
【０１４５】
図１０７（ｅ）：板状部材２１０４として、光反射領域を兼ねて導電性を有するアルミニウム系金属膜をスパッタリング技術により堆積させ、写真製版法及びドライエッチング法によりパターン化した。
図１０７（ｆ）：非晶質のシリコン膜をスパッタ法により堆積させ、第２の犠牲層１７０３とした。やはり犠牲層としては上記シリコン膜以外にもポリイミド膜や感光性有機膜（一般的に半導体プロセスにて用いられるレジスト膜）や多結晶シリコン膜などを用いることも出来る。第２の犠牲層１７０３は第１の犠牲層１７０２と同じ材質であることが望まれる。
【０１４６】
図１０７（ｇ）：光偏向装置２１００を個別に分離し、板状部材の周囲に規制部材２１０２を配置するために、写真製版法及びドライエッチング法により、第１の犠牲層１７０２及び第２の犠牲層１７０３を同時に板状部材２１０４よりやや広くパターン化した。
図１０７（ｈ）：規制部材２１０２を構成するシリコン酸化膜をプラズマＣＶＤ法により堆積させ、写真製版法及びドライエッチング法により任意の箇所にパターン化し規制部材２１０２とした。
図１０７（ｉ）：残存する第１の犠牲層１７０２及び第２の犠牲層１７０３を、テトラメチルアンモニウムヒドロキシド（ＴＭＡＨ）液によるウェットエッチング技術により、規制部材２１０２近傍の開口部を通して エッチング除去し、板状部材を可動範囲が制限された空間に配置して、本発明の光偏向装置が完成する。
【０１４７】
ここで、支点部材２１０３の形状について、図１０８、図１０９を用いて説明する。
図１０８（ａ）は基本となる円錐体を示した図である。この図では、円錐体２１０３の頂部２１０３ａは鋭い尖端となっている。板状部材２１０４に静電引力が作用したとき、これを支えるに当たって、両部材の接触点に応力が集中するため、該尖端形状を維持しきれなくなるおそれもあるので、図１０８（ｂ）のように、頂部２１０３ａを小さな球状に形成すると、安定した作動が得られるので良い。図１０８（ａ）、（ｂ）どちらの形状の場合も、図１０８（ｃ）に示すように、円錐体底面の下に該底面の径と同型の底面を有する円柱とを合体させた形状にするとさらによい。すなわち、支点部材の高さを同じにする場合、円錐体の頂角を大きくすることができるので、頂部の強度的安定性が得られる。このような形状にしても、使用上は全く同じに扱える。
【０１４８】
頂部を球状にする代わりに、平面にしても構わない。図１０９（ａ）のように円錐台形状にして、尖端形状をなくすと、応力集中の心配がさらになくなり、支点部材の破損などの

危険性がより少なくなる。図１０８（ｃ）と同様に、円錐台の底面の下に、該底面の径と同型の底面を有する円柱を合体させた図１０９（ｂ）のような形状でも構わない。効果は図１０８（ｃ）の場合とほぼ同様である。頂部２１０３ａの面積があまり大きくならなければ図１０９（ｃ）のように単なる円柱でも一応使うことはできる。この形状は円錐体の部分は無いが、製造が容易である。

【０１４９】

図１１０、１１１に、図９７で示した本発明の第２５実施形態における凸部位に対する、変形実施形態を示す。

図１１０において符号２００５は凸部位を示す。凸部位２００５は、図９７に示した実施例の凸部位７０１と同様の製造方法により得られ、同様の役割を果たすものであるが、その形状が凸部位７０１とは異なっている。

凸部位２００５は絶縁性膜により、４個の電極２３０１の上に、複数の帯状に配列されている。帯の幅、間隔、長さなどは、前述したとおり、板状部材２１０４が弾性変形により凹部位の電極２３０１へ接触しない範囲で任意の形状として、静電引力と板状部材の剛性の関係から設計することができる。凸部位を形成する斜面は、図９７に示す尾根状の頂部を有する柱状体の支点部材に限らず、図１０１の実施例で述べた、多角錐体の斜面でも良い。

凸部位を形成するためのフォトマスクを作成するに際し、これら凸部位の大きさは解像限界に近いため、図９７に示した円形のみの構成では精度が低下しやすい。そこで、本実施例のように、帯状に構成することによって面積的に大きくして、精度を出しやすくする。

【０１５０】

図１１１において符号２１０５は凸部位を示す。凸部位２１０５は、図９７に示した実施例の凸部位７０１とは一部異なる製造方法により形成されるが、その他に関しては上記凸部位２００５と同様である。

凸部位２１０５は、電極２３０１の上に載っているのではなく、電極と電極の間に突出しているような構成となっている。

【０１５１】

凸部位２１０５は、４個の電極を形成する前に、支点部材６０１の形成時に、所定のパターンによって形成しておく。支点部材６０１が絶縁性材料で形成されている場合は、支点部材６０１自身の表面をパターン化すれば良いが、支点部材６０１が導電性部材の場合は、支点部材６０１形成後表面に絶縁性膜を施してから、所定のパターンによって帯状の絶縁性凸部位２１０５を形成する。電極２３０１は凸部位２１０５の周囲の平坦部にのみ形成する。ただし、これとは別に、支点部材６０１の頂部には、板状部材２１０４に電位を供給するための導電部材６０２を形成する必要があるが、工程上は、上記電極２３０１を形成するときに、一緒に形成することができる。電極２３０１を凸部位以外のところにだけ設ける理由は、凸部位の下に電極がある場合は、凸部位表面に分極による静電荷が発生して、これが板状部材２１０４を吸着してしまう虞があるからである。この吸着が強くなると、電極に対する印加電圧が消滅した後も、板状部材２１０４が凸部位に吸着したまま離れない、いわゆる固着現象が発生することもある。

【０１５２】

図１１２は、図１０１に示した第９の実施例の円形の光偏向装置２１００を、最　密状態に並べて２次元的なアレー状に構成する場合の、規制部材の実施形態を示す図である。図は説明を容易にするため、最小の構成を示してあるが、実用上はこのような構成が縦及び横に多数配列されたものが使用される。

図において、符号２１０２'は２個の光偏向装置に共有された複合規制部材を示す。一般に円を最　密に並べた場合、１つの円の周囲には６個の円が等間隔に隙間無く並ぶ。したがって、規制部材２１０２は基板２１０１の円周上に等間隔に６個形成すると隣接する基板２１０１と規制部材の位置を一致させることができる。複数の光偏向装置２１００を集積化して一度に作る場合、規制部材の位置が一致していると両者を一体化して複合規制部材２１０２'として形成することができる。特に図示はしないが、１次元アレーの場合で

も隣接する基板同士の規制部材を一体化することができるのは同じである。ただし、１次元の場合の規制部材の個数は、図１０１に示す４個でも構わない。また、２次元アレーであっても、正方マトリクス状に配列する場合は、基板同士は縦、及び、横に連結されるので、規制部材は図１０１のように４個が丁度良い。

【０１５３】

図１１３は規制部材２１０２の変形実施形態を説明するための斜視図である。図１１４は上記変形実施形態の規制部材２１０２を用いた光偏向装置２１００の断面図である。

図１１３（ａ）に示す規制部材２１０２は、直立部２１０２ｃの頂部に設けられたストッパ２１０２ａの突出方向とは逆方向に突出した延長基部２１０２ｂを直立部２１０２ｃの下端部に有する。この規制部材２１０２は、図9.1、あるいは、図１０１に示すような、基板２１０１の周縁部に規制部材を設ける場合に用いる。図１１４からも分かるように、板状部材２１０４の可動範囲として規制される空間は、規制部材２１０２の延長基部2.１０２ｂの有る分だけ、基板２１０１よりも小さい範囲に限定される。このようにする理由は、規制部材２１０２が基板２１０１と接合する部分の面積があまり小さいと、わずかな応力にも破損しやすくなる虞があるためで、延長基部２１０２ｂによって上記接合面積を大きくすることによって、十分な強度が得られるようになる。

【０１５４】

図１１３（ｂ）に示す規制部材２１０２は、図９４に示すような角部における規制部材に関して、上記接合面積を大きくしたものである。使用法、及び、効果は上記と同じなので説明を省略する。

【０１５５】

図１１５は規制部材の更なる変形実施形態を示す斜視図である。

図１１６、１１７は変形実施形態の規制部材の使用例を示す断面図である。

図において、符号２１０２'は図１１２と同様、２個の光偏向装置に共有される複合規制部材を示す。複数の光偏向装置を並べてアレー状にして用いる場合、隣接する光偏向装置の連結位置において、規制部材を共有することができる。図１０２、あるいは、図１１２にその例が示されている。図１１５（ａ）に示す複合規制部材２１０２'は、図１１３に示した規制部材２１０２の変形であり、２個の規制部材の延長基部同士をつきあわせて連結した形の基部２１０２'ｂを有している。逆に言えば、隣接する２個の基板２１０１の境界線Ｋ上に、両基板に等分に跨って横たわる平板状の基部２１０２'ｂの対向する両端に、直立部２１０２'ｃを設け、両直立部２１０２'ｃの頂部に、前記境界線Ｋと逆方向に突出するストッパ２１０２ａをそれぞれ設けた形となっている。

【０１５６】

図１１５（ｂ）に示す複合規制部材２１０２'は、上記と同様な位置において、図９１に示す規制部材２１０２を２個、ストッパの存在しない側の面を、互いに密着させて連結した形になっており、アルファベットのＴの字の形に似ている。この構成では、図１１５（ａ）に示す直立部２１０２'ｃを２枚合わせた厚さ、または、それ以上の厚さとし、基板２１０１と接合する部分の面積が大きくしてあるので、特に基部としての形状を持たないが、十分な強度を有することになる。

【０１５７】

図１１８ないし図１２７は、本発明の他の実施形態に係わる光偏向装置の製造手順を示す図である。

図において、符号２８０２、２８０３、２８０４は第１、第２、第３の犠牲層をそれぞれ示す。

基板２１０１上に支点部材２１０３を形成する（図１１８）。

面方位［１００］を有するシリコン基板２１０１上に、支点部材２１０３を構成する酸化シリコン膜がプラズマＣＶＤ法により堆積され、その後、面積階調を有する、パターンを形成したフォトマスクを用いた写真製版法や、レジストパターン形成後熱変形させる写真製版法により、支点部材２１０３とほぼ同じ形状の任意の膜厚を有するレジストパターンを形成し、その後、ドライエッチング法の手法により目的形状の支点部材２１０３が形成

された。
なお、上記［１００］面方位を有するシリコン基板２１０１上に２μｍ程度の酸化シリコン膜を形成し、その上層１μｍ程度にて同様の加工を行っても良い。
また、支点部材２１０３の頂部２１０３αの高さはおよそ１μｍである。
【０１５８】
次いで、複数の電極２３０１を形成する（図１１９）。
電極２３０１は窒化チタン（ＴｉＮ）の薄膜で形成する。ＴｉＮ薄膜は、Ｔｉをターゲットとしたマグネトロンスパッタ法により、厚さ０．０１μｍに成膜し、写真製版法、及び、ドライエッチング法の手法により、複数の、たとえば、４個の電極２３０１としてパターン化した。
次に、電極２３０１の上に保護膜２３０１αを形成する（図１２０）。
保護膜２３０１αとしては、プラズマＣＶＤ法により、シリコン窒化膜を膜厚０．２μｍで形成した。
【０１５９】
次に、第１の犠牲層２８０２を形成する（図１２１）。
第１の犠牲層２８０２として、非晶質シリコン膜をスパッタ法により２μｍ堆積させ、ＣＭＰ技術を用いて処理時間制御にて、支点部材２１０３の頂部２１０３αが露出させ、さらに時間をオーバーさせて平坦化させる。このとき、支点部材２１０３、及び、保護膜２３０１αとの研磨選択性の高いＣＭＰ条件とすることにより、支点部材２１０３の頂点近傍では、頂部２１０３αが残存し、非晶質シリコン膜が薄く存在する。支点部材２１０３の頂点部が約０．２μｍ突出した。残存する非晶質シリコン膜が第１の犠牲層２８０２である。第１の犠牲層としては、上記以外にも、ポリイミド膜や感光性有機膜、あるいは、一般的に半導体プロセスにて用いられるレジスト膜や多結晶シリコン膜などを用いることもできる。また、平坦化の手法としては、ドライエッチングによるエッチバック法を用いることもできる。
【０１６０】
次いで、第２の犠牲層２８０３を形成する（図１２２）。
非晶質シリコン膜をスパッタ法により支点部材２１０３の先端部まで含めて０．１μｍ堆積させた。
【０１６１】
次に、板状部材２１０４の誘電体層２２０１と導電体層２２０２を形成する（図１２３）。
誘電体層２２０１となる基材として、シリコン窒化膜をプラズマＣＶＤ法により、厚さ０．２μｍで堆積させ、引き続き、光反射領域を兼ねる導電体層２２０２となる、アルミニウム系金属膜を０．０５μｍの厚さで、スパッタリング技術により堆積させた。その後、上記金属膜と上記シリコン窒化膜を、それぞれ、写真製版法、及び、ドライエッチング法によりパターン化した。後の工程で、基板２１０１の周縁部に、規制部材２１０２を形成するためのスペースを残すため、誘電体層２２０１は基板２１０１より小さめに形成する。また、導電体層２２０２は、誘電体層２２０１の上に載るように、それより小さめに形成する。
【０１６２】
次に、第３の犠牲層２８０４を形成する（図１２４）。
非晶質のシリコン膜をスパッタ法により、１μｍ堆積させ、第３の犠牲層２９０４とした。なお、第３の犠牲層としては、上記以外にも、ポリイミド膜や感光性有機膜、あるいは、一般的に半導体プロセスにて用いられるレジスト膜や多結晶シリコン膜などを用いることもできる。
【０１６３】
次に、規制部材２１０２を形成するスペースを作る（図１２５）。
写真製版法、及び、ドライエッチング法により、第１の犠牲層、第２の犠牲層、および第３に犠牲層を同時にパターン化して、基板２１０１の周縁部に沿った部分を除去し、規制

部材２１０２用のスペースを形成する。このとき、残す犠牲層の大きさは誘電体層２２０１が露出しないように誘電体層２２０１の大きさよりも大きくしておく。

【０１６４】

次に、規制部材２１０２を形成する（図１２６）。

酸化シリコン膜をプラズマＣＶＤ法により厚さ０．８μｍで堆積させ、写真製版法、及び、ドライエッチング法により、パターン化して、規制部材２１０２を形成した。なお、規制部材２１０２は図示の形状に限るものではなく、図１１３、１１５に示したように種々の変形があり得る。

【０１６５】

最後に、犠牲層の除去を行う（図１２７）。

残存する第１ないし第３の犠牲層、２８０２、２８０３および２８０４を、ウェットエッチング技術により、開口部を通してエッチング除去し、反射面を有した板状部材２１０４の可動範囲が、基板２１０１と、規制部材２１０２と、支点部材２１０３によって所定の空間に規制された光偏向装置２１００が得られた。

【０１６６】

この製造方法では、板状部材２１０４の裏面の中央部が、支点部材２１０３と凹凸の関係で組み合わさるようになり、板状部材２１０４が電極２３０１から静電引力を受けて傾斜する場合にも、横滑りが生ぜず、中央部が常に一定した位置にあるので、マイクロミラーデバイスとして用いた場合、反射光の方向制御が精度良くできるようになる。

【０１６７】

本発明の作用効果を全体的に述べると、ミラーの役割をする板状部材が斜面や基板に接触して傾斜角が決まることから、ミラーの偏向角の制御が容易かつ安定である。支点部材を中心として対向する電極に異なる電位を印加することにより高速に板状部材を反転できるので、応答速度が速くできる。板状部材が固定端を有していないのでねじり変形などの変形を伴わず長期的な劣化が少なく低電圧で駆動できる。半導体製造技術により微細で軽量な板状部材を形成できるので、規制部材との衝突による衝撃が少なく、長期的な劣化が少ない。規制部材や板状部材の構成を任意に決めることにより、反射光のＯＮ／ＯＦＦ比（画像機器におけるＳ／Ｎ比、映像機器におけるコントラスト比）を向上できる。半導体製造技術及び装置を使用できるので低コストにて微細化と集積化が可能である。また、支点部材を中心として複数の電極を配置することにより、１軸及び２軸方向の光偏向が可能である。

【０１６８】

【発明の効果】

本発明は、以上説明したように構成されているので、請求項１の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を、基板上に固定することなく基板上の支点部材上と笠形状の笠形状部材間に形成される空隙内に変位が自由の状態で配置して、基板上の支点部材の周囲に板形状部材と対向して配置した電極に電位を付与して、支点部材上に傾斜して載置する板形状部材上の反射手段で入射光の反射方向を１軸又は２軸方向に変えて光偏向を行うようにしたので、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向方法を提供することが出来るようになった。

請求項２の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を、基板上に固定することなく基板上の支点部材上と笠形状の笠形状部材間に形成される空隙内に変位が自由の状態で配置して、基板上の支点部材の周囲に板形状部材と対向して配置した電極に電位を付与して、支点部材上に傾斜して載置する板形状部材上の反射手段で入射光の反射方向を１軸又は２軸方向に変えると共に電極は基板上の支点部材の周囲に板形状部材と対向して配列した複数個の各電極に異なる電位を付与して光偏向を行うようにしたので、板形状部材を目的の方向へ変位、又は、変位

方向の高速での変更、傾斜の向きを２軸方向で高精度に制御することも出来るようになり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が安定で応答も更に速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向方法を提供することが出来るようになった。

【０１６９】

請求項３の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を、基板上に固定することなく基板上の支点部材上と笠形状の笠形状部材間に形成される空隙内に変位が自由の状態で配置して、基板上の支点部材の周囲に板形状部材と対向して配置した電極に電位を付与して、支点部材上に傾斜して載置する板形状部材上の反射手段で入射光の反射方向を１軸又は２軸方向に変えると共に電極に異なる電位を付与して反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を基板上の斜面に接触して入射光の反射方向を接触する位置で規定して変えて光偏向を行うようにしたので、板形状部材の変位による接触時の衝撃を分散し、変位方向の制御が容易になり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が更に安定で応答も更に速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向方法を提供することが出来るようになった。

請求項４の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置するようにしたので、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

【０１７０】

請求項５の発明によれば、入射光を反射する反射面が平板で形成された反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置するようにしたので、光反射領域に入射した光束は反射方向を揃えて反射することが可能で、反射光を拡散することなく目的の反射方向にのみ光変更が可能となり、光偏向装置を各光情報処理装置、画像形成装置、画像投影表示装置及び光伝送装置等に用いる場合にも隣接素子への影響が抑制され、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が更に安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

請求項６の発明によれば、入射光を反射するアルミニウム系金属膜で形成された反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置するようにしたので、反射手段又は板形状部材の少なくとも一部に形成される導電性領域を兼ねて反射性能も良好であり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時

にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で更に低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。
請求項７の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置すると共に板形状部材は支点部材と接する個所の面形状に湾曲形状の湾曲形状部からなるようにしたので、支点部材に対する板形状部材の位置決めが自発的に容易となり、板形状部材の変位時に板形状部材が笠形状部材５側面に接触することを抑制され、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が更に安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が更に少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。
【０１７１】
請求項８の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状で外形が円形状である板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置するようにしたので、板形状部材に組み合わされた反射手段の反射面の反射領域にて反射した反射光が円形となり、光偏向装置を具備する上記画像形成装置や画像投影装置等における１画素を円形状として隣接画素の隙間部をドット状に点在させることにより矩形な板形状部材による矩形な画素形状の隣接画素の隙間部が線状の筋となるのと異なり高精彩な画像が得られ、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。
請求項９の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状のシリコン窒化膜からなる板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置するようにしたので、板形状部材は高い絶縁破壊電圧を有し且つ長期的な劣化即ち繰り返し変位に伴う疲労に対する耐性も高いので極力軽量及び薄膜化できそれにより高い周波数における駆動が可能な即ち数１０ｋＨｚ以上の高速動作が可能となり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が更に安定で応答も更に速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が更に少なく、駆動電圧が更に低く省資源で、微細化と集積化が更に可能で更に低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。
【０１７２】
請求項１０の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置すると共に反射手段又は板形状部材は導電性を有する導電性領域を有して導電性領域が電極と対向するようにしたので、複数の電極間に任意に電位差を生じさせることにより、より低い駆動電圧で板形状部材を目的の方向へ変位、又は、引き続き変位方向を高速で変え、又は、傾斜の向きを２軸方向で高精度に制御することが出来るようになり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容

易で作動が安定で応答も更に速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が更に低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

請求項１１の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する窪み形状の窪み形状部からなる基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置するようにしたので、笠形状部材の高さが低くなり、歩留まりが向上して、更に、笠形状部材自体の自立安定につながり機械的強度を高め、製造方法により空隙（Ｇ）の高さの制御性を向上でき駆動電圧、及び、リセット電圧の制御性が良くなり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が更に少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

【０１７３】

請求項１２の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する（１００）面方位を有するシリコン基板からなる基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置するようにしたので、同一基板内に複雑な駆動系回路を簡単に形成されて、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で更に低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

請求項１３の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置すると共に支点部材は板形状部材と接する個所の面形状が円形状部であるようにしたので、板形状部材と支点部材の接触面積を低下させて２軸方向の光偏向が容易となり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

【０１７４】

請求項１４の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置すると共に支点部材は板形状部材と点で接する円錐形状部であるようにしたので、支点部材の支点部位の基板側の機械的強度を強めることが出来、且つ、板形状部材の変位は、板形状部材の端部における基板の上面との接触部で規定されるので、接触面積を極力低減して板形状部材の基板３への固着や接触帯電を抑制できる、支点部材が板形状部材と接触する領域において点形状を有することから静電引力に作用する方向に対応した任意の方向へ板形状部材を傾斜変位させることが容易に可能となり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が更に安定で応答

も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が更に少なく、駆動電圧が更に低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

請求項１５の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置すると共に支点部材は板形状部材と接する面が長方形の長方形状部であるようにしたので、支点部材の短尺方向への支点部材傾斜変位、即ち、１軸方向の板形状部材の静電引力による傾斜変位が安定して起こり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が更に安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

【０１７５】

請求項１６の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置すると共に支点部材は板形状部材と線で接する尾根の形状からなる尾根形状部であるようにしたので、支点部材の尾根形状部と板形状部材の接触面積を低減して１軸方向の板形状部材の静電引力による傾斜変位が安定して起こされ、支点部材の尾根形状部が斜面を有することから支点部材の機械的強度を強め、且つ、板形状部材の変位は板形状部材の端部における基板の上面との接触部で規定されるので、接触面積を極力低減して板形状部材の基板への固着や接触帯電が抑制でき、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が更に安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が更に少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

請求項１７の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置すると共に支点部材は板形状部材と接する斜面を有するようにしたので、電極の全面に接触して板形状部材を変位させることが出来るので接触時の衝撃を分散させ変位方向の制御が容易となり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が更に安定で応答も更に速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

【０１７６】

請求項１８の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる酸化シリコン膜又はシリコン窒化膜からなる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置するようにしたので、支点部材は機械的強度が強くなり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が更に少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供する

ことが出来るようになった。
請求項１９の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置すると共に笠形状部材は板形状部材の外周に対応して複数個の各笠形状部材を所定間隔を空けて配置するようにしたので、犠牲層のエッチング除去時に要する時間が短縮化され歩留まりも向上して、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で更に低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。
【０１７７】
請求項２０の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置すると共に笠形状部材は板形状部材の外周に対応する全領域に配置するようにしたので、板形状部材が機械的に可動範囲を制限された空隙よりはみ出し故障することを極力低減され、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が更に安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が更に少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。
請求項２１の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の絶縁性を有する絶縁膜からなる笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置するようにしたので、板形状部材が笠形状部材に接触した場合でも電気的に浮いている板形状部材の電荷が笠形状部材を経由して移動しないので板形状部材の電位が変動することが抑制され、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が更に安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。
【０１７８】
請求項２２の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の入射光束に対し透光性を有する透光性膜からなる笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置するようにしたので、板形状部材と組み合わせ構成される反射手段の反射面の光反射領域の笠形状部材と重なる領域からの反射光も寄与させることが出来るので１素子における反射光の面積及び光量を増加させることが出来るのでＯＮ光量が増大して、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が更に安定で応答も更に速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。
請求項２３の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部

材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の酸化シリコン膜からなる笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置するようにしたので、笠形状部材が高い絶縁性と高い透光性を両立して微細化と集積化の作製も可能となり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が更に安定で応答も更に速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が更に可能で更に低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。請求項２４の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の入射光束に対し遮光性を有する遮光性膜からなる笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置するようにしたので、笠形状部材に入射した光束の望まれない方向への反射が抑制されて目的方向への光偏向の迷光が低下してＯＦＦ光量が抑制されて、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が更に安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

【０１７９】

請求項２５の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の酸化クロム膜からなる笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置するようにしたので、笠形状部材が高い絶縁性と高い遮光性を両立して微細化と集積化の作製が可能となり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が更に安定で応答も更に速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で更に低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

請求項２６の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置すると共に電極は複数個の各電極からなり板形状部材は電気的に浮いているようにしたので、板形状部材を目的の方向へ変位させて、引き続き変位方向を高速で変えて、更に任意に電位差を生じさせることにより板形状部材の傾斜の向きを２軸方向で高精度に制御されて、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が安定で応答も更に速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

【０１８０】

請求項２７の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置すると共に電極は板形状部材の裏面と対向した斜面上に配置した複数個の各電極からななり板形状部材は電気的に浮いているようにしたので、板形状部材の変位をより低電圧で駆動可能で、板形状部材の接触時の衝撃が分散され、板形状部材を目的の方

向へ変位させて、引き続き変位方向を高速で変えて、更に任意に電位差を生じさせることにより板形状部材の傾斜の向きを２軸方向で高精度に制御されて、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が更に簡単容易で作動が安定で応答も更に速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が更に少なく、駆動電圧が更に低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

請求項２８の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置すると共に１次元アレー状に配列した１次元光偏向アレーを形成するようにしたので、画像形成装置における潜像形成手段等に使用することが出来る、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

【０１８１】

請求項２９の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置すると共に２次元アレー状に配列した２次元光偏向アレーを形成するようにしたので、画像投影表示装置における光スイッチ手段等に使用することが出来る、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を提供することが出来るようになった。

請求項３０の発明によれば、基板上に支点部材と電極を形成し、堆積して平坦化した第１の犠牲層を介して反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を形成して、更に堆積した第２の犠牲層とをパターン化した所定の位置に笠形状部材をパターン化した後に、第１の犠牲層と第２の犠牲層を除去するようにしたので、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置の製造方法を提供することが出来るようになった。

請求項３１の発明によれば、基板上に支点部材と電極を形成し、支点部材を突出させて堆積して平坦化した第１の犠牲層に重ねて堆積して平坦化した第３の犠牲層を介して反射手段を表面に組み合わせ構成する薄膜で形成された湾曲形状の湾曲形状部からなる板形状部材を形成して、更に堆積した第２の犠牲層とをパターン化した所定の位置に笠形状部材をパターン化した後に、第１の犠牲層と第２の犠牲層と第３の犠牲層を除去するようにしたので、静電引力により板形状部材が傾斜変位する時に、板形状部材の変位時に湾曲形状部を中心とした変位が可能となり、板形状部材がずれることを抑制し、言い換えると、支点部材に対する板形状部材の位置決めが自発的に容易となり、板形状部材の変位時に、板形状部材が笠形状部材の側面に接触することを抑制して、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が更に安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が更に少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置の製造方法を提供することが出来るようになった。

【０１８２】

請求項３２の発明によれば、基板上に窪み形状部と窪み形状部内に斜面からなる支点部材

と電極を形成し、堆積して平坦化した第１の犠牲層を介して反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を形成して、更に堆積した第２の犠牲層とをパターン化した所定の位置に笠形状部材をパターン化した後に、第１の犠牲層と第２の犠牲層を除去するようにしたので、笠形状部材の高さが低くなり、笠形状部材自体の自立安定につながり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が更に少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置の製造方法を提供することが出来るようになった。

請求項３３の発明によれば、基板上に支点部材と電極を形成し、堆積して平坦化した第１の犠牲層を介して反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を形成して、更に堆積した第２の犠牲層とをパターン化した所定の位置に笠形状部材をパターン化した後に、笠形状部材の複数個の各笠形状部材間を空けて配置した所定間隔から第１の犠牲層と第２の犠牲層を除去するようにしたので、犠牲層のエッチング作業が短縮化して、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で更に低コストで、使用環境も制限されない光偏向装置の製造方法を提供することが出来るようになった。

【０１８３】

請求項３４の発明によれば、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置した光偏向装置を独立駆動手段で各々独立に駆動するようにしたので、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を具備して、構造と制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制する光偏向装置を具備する光情報処理装置を提供することが出来るようになった。

請求項３５の発明によれば、回動可能に保持されて形成画像を担持する画像担持体上に光書き込みを行なって潜像を形成する、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置した光偏向装置からなる潜像形成手段の上記光偏向装置によって形成された潜像を顕像化してトナー画像を形成する現像手段で形成されたトナー画像を転写手段によって被転写体に転写して画像を形成するようにしたので、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を具備して、構造と制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制して、光書き込み時のＯＮ／ＯＦＦ制御が良好で高速動作が可能で、且つ、長期的な信頼性が高く、低電圧で駆動され、Ｓ／Ｎ比も向上出来る高速で高精彩な画像を形成する光偏向装置を具備する画像形成装置を提供することが出来るようになった。

【０１８４】

請求項３６の発明によれば、画像投影データの入射光の反射方向を変えて光偏向を行なって画像を投影して表示する、入射光を反射する反射手段を表面に組み合わせ構成する薄膜

で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置した光偏向装置からなる光スイッチ手段が投影スクリーンに画像を投影して表示するようにしたので、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を具備して、構造と制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制して、画像の明暗制御時のＯＮ／ＯＦＦ制御が良好で高速動作が可能で、且つ、長期的な信頼性が高く、低電圧で駆動され、コントラスト比も向上出来るので、高輝度でありながら高いコントラストを有する高精細な画像を投影して表示する光偏向装置を具備する画像投影表示装置を提供することが出来るようになった。

請求項３７の発明によれば、光信号を入力する光信号入力手段からの光信号の入射光の反射方向を１軸又は２軸方向に変えて光偏向を行なって、各光信号の光路を決定する、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置した光偏向装置からなる光スイッチ手段からの光信号を光信号出力手段で出力するようにしたので、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を具備して、構造と制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制して、２軸方向の光偏向を容易に正確に行なうことが出来、各ポートの選択の制御が良好で隣接ポートへの迷光、を抑制して、高速な光路切替が可能で、長期的な信頼性が高く、低電圧で駆動され、同一基板上に集積化が出来るので、小型でありながら高速で誤動作の少ない光信号の光路を決定して出力して伝送する光偏向装置を具備する光伝送装置を提供することが出来るようになった。

【０１８５】

請求項３８の発明によれば、光信号を入力する光信号入力手段からの光信号の入射光の反射方向を１軸又は２軸方向に変えて光偏向を行なって、各光信号の光路を決定する、入射光を反射する反射手段を表面に組み合わせ構成する薄膜で形成された板形状の板形状部材を固定することなく載置する基板上の傾斜する板形状部材の変位時の支点となる支点部材上に板形状部材を変位が自由の状態で配置される空隙を形成する笠形状の笠形状部材からなり基板上の支点部材の周囲に板形状部材の裏面と対向して電極を配置した複数段の光偏向装置からなる光スイッチ手段からの光信号を光信号出力手段で出力するようにしたので、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易で作動が安定で応答も速く、使用する入射光の波長が制限されることなく、機械的強度が長期間使用時にも変化と劣化が少なく、駆動電圧が低く省資源で、微細化と集積化が可能で低コストで、使用環境も制限されない光偏向装置を具備して、光偏向角が大きく、構造と制御が簡単容易で、且つ、迷光、反射方向が乱れた時に発生する隣接素子からの反射光を抑制して、２軸方向の光偏向を容易に正確に行なうこと出来、各ポートの選択の制御が良好で隣接ポートへの迷光、を抑制して、高速な光路切替が可能で、長期的な信頼性が高く、低電圧で駆動され、同一基板上に集積化が出来るので、小型でありながら高速で誤動作の少ない光信号の光路を決定して出力して伝送する光偏向装置を具備する光伝送装置を提供することが出来るようになった。

請求項３９ないし４３の発明によれば、支点部材が板形状部材と接触する領域において点形状を有することから静電引力に作用する方向に対応した任意の方向へ板形状部材を傾斜

変位させることが容易に可能となり、入射光の反射方向を１軸又は２軸方向に変えて光偏向を行う構造と制御が簡単容易である。
請求項４４ないし５７の発明によれば、支点部材が板形状部材と接触する領域において点形状を有することから静電引力に作用する方向に対応した任意の方向へ板形状部材を傾斜変位させることが容易に可能となり、入射光の反射方向を複数軸方向に変えて光偏向を行う構造と制御が簡単容易である。
【０１８６】
請求項５８の発明によれば、板状部材と支点部材の互いに接触する部位が導電性であるため、両者の間の接触抵抗を低減でき、低電圧駆動ができる。支点部材を中心とした板状部材の支点を中心とした傾斜を基板に接触するまで行うことにより、ミラーの偏向角の制御が容易かつ安定とすることができる。また、板状部材が固定端を有していないので、ねじり又は変形が生じるようなヒンジ、あるいは、固定梁部が存在せず、長期的な使用における脆性劣化などの劣化が少なく、かつ変形を生じさせることがない分そのための力が不要なので低電圧で駆動できる。また、規制部材により板状部材を任意の空間にほぼ位置付けできるので、リセット動作時のリセット電圧を極力低くすることが出来る。また、板状部材の電位を、支点部材を経由して任意の電位とすることにより、さらに低電圧で安定に駆動することができる。
【０１８７】
請求項５９の発明によれば、入射する光束を最大限利用できる。
請求項６０の発明によれば、板状部材が誘電性を有する部材を有することから、板状部材の電位を誘電性を有する部材に保持することが可能となり、板状部材と支点部材の接触が瞬間的に断たれた場合も板状部材の電位を保持できるので、板状部材の傾斜を安定に駆動できる。
請求項６１の発明によれば、板状部材の電位を誘電性を有する部材に保持することが容易となり、かつより効率的に誘電することが可能なので、板状部材の傾斜をより安定に低電圧で駆動できる。
【０１８８】
請求項６２の発明によれば、高い比誘電率を確保しながら高い絶縁性を有しかつ高い機械的強度を有するので、板状部材と電極との電気的短絡を抑制でき、板状部材の変位時の破壊を抑制できる。
請求項６３の発明によれば、基板に形成された複数の電極と支点部材の頂部の、導電性の部位とが電気的に分離されていることから、板状部材に与える電位は基板上の電極とは独立したものとすることができる。
【０１８９】
請求項６４の発明によれば、板状部材と電極との間に所定値以上の電位差を与えた場合、両者は少なくともその一部が対向しているので、両者の間に静電引力を働かせることができる。
請求項６５の発明によれば、板状部材は支点部材の頂部を接触点として、あらゆる方向に変位が可能である。
【０１９０】
請求項６６の発明によれば、あらゆる方向に変位可能な板状部材を複数の斜面のいずれかに接触させることで変位方向を安定的に確定させることができる。
請求項６７の発明によれば、板状部材は支点部材と線接触をなすので、接触線を軸とした２方向のみの変位に限定されるが、簡易な装置に用いる場合安定性が非常に高いので精度のよい装置が得られる。
【０１９１】
請求項６８の発明によれば、電極が漸近的に板状部材に近接しているので、より低い電位差でも静電引力による板状部材の変位を引き起こすことができるようになる。
請求項６９の発明によれば、板状部材が変位したとき、板状部材の裏面全体が斜面と接触するので、変位状態が非常に安定するとともに、接触時の衝撃を分散させることができ、

それにより長期的な強度劣化の少ない光偏向装置を提供することができる。

【０１９２】

請求項７０の発明によれば、板状部材が斜面に接触状態になったときも、板状部材裏面の全面が斜面に接触するのではなく、凸部位のみに接触するので、接触面積を低減して板状部材の基板への固着を抑制でき、高い信頼性を有する光偏向装置を提供することができる。

請求項７１の発明によれば、光偏向アレーにおいては、板状部材の近傍の雰囲気がほぼ真空であることから、板状部材の変位時に雰囲気中の気体による浮力を受けることが無いので、隣接する素子間の気体の流入及び流出の問題を解消でき、素子間における板状部材の変位の相互作用をなくすことが出来る。光偏向装置においては、装置周囲をカバーで覆うようにパッケージ化した場合、電圧印加による板状部材の急速な傾斜の変化に対して雰囲気の気体が粘性抵抗となり、わずかな応答遅れが生ずることを防ぐことができる。

【０１９３】

請求項７２の発明によれば、雰囲気中の水分を低減することができ、それにより、板状部材が傾斜変位し基板へ接触した時の接触点及び支点部材と板状部材の接触点における固着を抑制することができる。

請求項７３の発明によれば、支点部材の頂部を挟んで対向する電極に与える電位の最大値と最小値の関係を切り替えるか、あるいは、板状部材に与える電位を最大値側と最小値側の間で切り替えることにより板状部材の変位方向を逆側に切り替えることができる。また、電極に与える最大電位、もしくは、最小電位を隣接その他の電極に切り替えることにより、さらに多くの変位方向を得ることができる。

【０１９４】

請求項７４の発明によれば、特に電極の数を６個以上にすれば、最大電位を与える電極と最小電位を与える電極との間に、電気的に浮いた状態の電極を１個以上挟むことが可能になり、隣接する電極同士の間に高い電位差が生じることがなく、安定した動作が得られる。

請求項７５の発明によれば、板状部材の残留応力によるミラー面における反りを容易に抑制できるので目的方向以外への反射光を抑制でき、反射光量のＳ／Ｎ比を高めることができる。

【０１９５】

請求項７６の発明によれば、アルミニウム系金属膜の反射率が良好なことから、ミラーとしての反射性能を高くすることが出来る。さらに、アルミニウム系金属膜の電気抵抗が低いことから、支点部材からの電位の付与を効果的に行うことが出来、低電圧で駆動することが出来る。

【０１９６】

請求項７７の発明によれば、複数の素子を同時にかつ独立に駆動制御して光偏向させることが可能になる。

請求項７８の発明によれば、光スイッチのＯＮ／ＯＦＦ制御による画素の明暗制御が良好でかつ迷光を抑制でき、高速な動作が可能で、長期的な信頼性が高く、低電圧で駆動でき、コントラスト比を向上できるので、高輝度でありながら高いコントラスト比を有する高精細な画像投影表示装置を提供することができる。請求項７９の発明によれば、基板表面に形成された支点部材に板状部材が接触する場合に板状部材に重力が作用するが、どの電極の方向への板状部材の傾斜も、重力が均等に作用し、偏りがない。それにより、板状部材が傾斜変位する場合にさらに安定した動作、すなわち、長期信頼性や繰り返し再現性のある動作を得ることができる。

【０１９７】

請求項８０の発明によれば、光書込み時のＯＮ／ＯＦＦ制御が良好でかつ迷光を抑制でき、高速な動作が可能で、長期的な信頼性が高く、低電圧で駆動でき、Ｓ／Ｎ比を向上できるので、高速かつ高精彩な画像形成装置を提供することができる。

請求項８１の発明によれば、基板表面に形成された支点部材に板状部材が接触する場合に

板状部材に重力が作用するが、どの電極の方向への板状部材の傾斜も、重力が均等に作用し、偏りがない。それにより、板状部材が傾斜変位する場合にさらに安定した動作、すなわち、長期信頼性や繰り返し再現性のある動作を得ることができる。

【０１９８】

請求項８２の発明によれば、１個の入出力ポートに対する複数の入出力ポートの選択の制御が良好で、隣接ポートへの迷光を抑制でき、高速な光路切替が可能で、長期的な信頼性が高く、低電圧で駆動でき、同一基板上に集積化できるので、小型でありながら高速かつ誤動作の少ない光伝送装置を提供することができる。

請求項８３の発明によれば、一方の入出力部の複数の入出力ポートと他方の入出力部の複数の入出力ポートの選択の制御が良好で、隣接ポートへの迷光を抑制でき、高速な光路切替が可能で、長期的な信頼性が高く、低電圧で駆動でき、同一基板上に集積化できるので、小型でありながら高速かつ誤動作の少ない光伝送装置を提供することができる。

請求項８４の発明によれば、基板表面に形成された支点部材に板状部材が接触する場合に板状部材に重力が作用するが、どの電極の方向への板状部材の傾斜も、重力が均等に作用し、偏りがない。それにより、板状部材が傾斜変位する場合にさらに安定した動作、すなわち、長期信頼性や繰り返し再現性のある動作を得ることができる。

【０１９９】

請求項８５の発明によれば、高歩留及び高集積及び微細な光偏向装置を同一基板上に製造することができる。また、微細に本発明の光偏向装置を製造できることから板状部材の重量を低減でき、それにより待機時に板状部材が規制部材に衝突した場合の衝撃や、動作時に板状部材が基板に接触した場合の衝撃を低減でき、高い信頼性を有する光偏向装置を提供することができる。

請求項８６の発明によれば、高歩留及び高集積及び微細な光偏向アレーを同一基板上に製造することができる。また、微細に本発明の光偏向アレーを製造できることから板状部材の重量を低減でき、それにより待機時に板状部材が規制部材に衝突した場合の衝撃や、動作時に板状部材が基板に接触した場合の衝撃を低減でき、高い信頼性を有する光偏向アレーを提供することができる。

【０２００】

請求項８７の発明によれば、任意の大きさの凸部位を形成できるので、板状部材の吸着力を低減し、固着を抑制した、安定した駆動が可能な光偏向装置を、同一基板上に製造することができる。

【０２０１】

請求項８８の発明によれば、円錐体の頂部が球状であることにより、応力集中が避けられ、安定した作動が得られる。

【０２０２】

請求項８９の発明によれば、円錐体の頂角を大きくすることができ、頂部の強度的安定性が得られる。

【０２０３】

請求項９０の発明によれば、支点部材の頂部に尖端形状がないので応力集中による支点部材の破損などの危険性がより少なくなる。

【０２０４】

請求項９１の発明によれば、頂部の強度的安定性が得られる。

【０２０５】

請求項９２の発明によれば、製造容易な支点部材が得られる。

【０２０６】

請求項９３の発明によれば、板状部材と点接触をする多角錐形状の支点部材を用いる光偏向装置において、板状部材が斜面に接触状態になったときも、板状部材裏面の全面が斜面に接触するのではなく、凸部位のみに接触するので、接触面積を低減して板状部材の基板への固着を抑制でき、高い信頼性を有する光偏向装置を提供することができる。また、凸部位のパターニングに際し、フォトマスクの作成が容易になる。

【０２０７】
請求項９４の発明によれば、板状部材と点接触をする多角錐形状の支点部材を用いる光偏向装置において、支点部材の斜面上の凸部位への板状部材の固着現象を予防することができる。
【０２０８】
請求項９５の発明によれば、板状部材と線接触をする角柱形状の支点部材を用いる光偏向装置において、板状部材が斜面に接触状態になったときも、板状部材裏面の全面が斜面に接触するのではなく、凸部位のみに接触するので、接触面積を低減して板状部材の基板への固着を抑制でき、高い信頼性を有する光偏向装置を提供することができる。また、フォトマスクの作成が容易になるほか、凸部位における帯電の可能性が低くなり、板状部材の固着の確率が低くなる。
【０２０９】
請求項９６の発明によれば、板状部材と線接触をする角柱形状の支点部材を用いる光偏向装置において、支点部材の斜面上の凸部位への板状部材の固着現象を予防することができる。
【０２１０】
請求項９７の発明によれば、入射する光束を最大限利用できる。
【０２１１】
請求項９８の発明によれば、板状部材が誘電性を有する部材を有することから、板状部材の電位を誘電性を有する部材に保持することが可能となり、板状部材と支点部材の接触が瞬間的に断たれた場合も板状部材の電位を保持できるので、板状部材の傾斜を安定に駆動できる。
【０２１２】
請求項９９の発明によれば、板状部材の電位を誘電性を有する部材に保持することが容易となり、かつより効率的に誘電することが可能なので、板状部材の傾斜をより安定に低電圧で駆動できる。
【０２１３】
請求項１００の発明によれば、高い比誘電率を確保しながら高い絶縁性を有しかつ高い機械的強度を有するので、板状部材と電極との電気的短絡を抑制でき、板状部材の変位時の破壊を抑制できる。
【０２１４】
請求項１０１の発明によれば、基板に形成された複数の電極と支点部材の頂部の、導電性の部位とが電気的に分離されていることから、板状部材に与える電位は基板上の電極とは独立したものとすることができる。
【０２１５】
請求項１０２の発明によれば、板状部材と電極との間に所定値以上の電位差を与えた場合、両者は少なくともその一部が対向しているので、両者の間に静電引力を働かせることができる。
【０２１６】
請求項１０３の発明によれば、延長基部によって規制部材が基板と接合する部分の接合面積を大きくすることによって、応力等に対し十分な強度が得られるようになる。
【０２１７】
請求項１０４の発明によれば、アレー状に配列した複数の光偏向装置の、互いに隣り合う２個の光偏向装置の規制部材の位置を一致させて、一体化させて形成するので、規制部材の強度の安定化が得られる。
【０２１８】
請求項１０５の発明によれば、面積の利用効率が最大になり、すべての隣接する光偏向装置において、互いに規制部材を共有した複合規制部材とすることができる。
【０２１９】
請求項１０６の発明によれば、隣接する光偏向装置が無い位置においても、規制部材が基

板と接合する接合面積を大きくできるので、規制部材の安定した強度が得られる。
【０２２０】
請求項１０７の発明によれば、隣接する２個の光偏向装置において共有される複合規制部材の基部において、基板との接合面積が大きくできるので安定した強度が得られる。
【０２２１】
請求項１０８の発明によれば、隣接する２個の光偏向装置において共有される複合規制部材の直立部において、基板との接合面積が大きくできるので安定した強度が得られる。
【０２２２】
請求項１０９の発明によれば、高歩留及び高集積及び微細な光偏向装置を同一基板上に製造することができる。また、微細に本発明の光偏向装置を製造できることから板状部材の重量を低減でき、それにより待機時に板状部材が規制部材に衝突した場合の衝撃や、動作時に板状部材が基板に接触した場合の衝撃を低減でき、高い信頼性を有する光偏向装置を提供することができる。
【０２２３】
請求項１１０の発明によれば、板状部材の裏面の中央部が、支点部材と凹凸の関係で組み合わさるようになり、板状部材が電極から静電引力を受けて傾斜する場合にも、横滑りが生ぜず、中央部が常に一定した位置にあるので、マイクロミラーデバイスとして用いた場合、反射光の方向制御が精度良くできるようになる。
【０２２４】
請求項１１１の発明によれば、高歩留及び高集積及び微細な光偏向アレーを同一基板上に製造することができる。また、微細に本発明の光偏向アレーを製造できることから板状部材の重量を低減でき、それにより待機時に板状部材が規制部材に衝突した場合の衝撃や、動作時に板状部材が基板に接触した場合の衝撃を低減でき、高い信頼性を有する光偏向アレーを提供することができる
【０２２５】
請求項１１２の発明によれば、光偏向アレーにおいて、板状部材の裏面の中央部が、支点部材と凹凸の関係で組み合わさるようになり、板状部材が電極から静電引力を受けて傾斜する場合にも、横滑りが生ぜず、中央部が常に一定した位置にあるので、マイクロミラーデバイスとして用いた場合、反射光の方向制御が精度良くできるようになる。
【図面の簡単な説明】
【図１】本発明の第１の実施形態に係る光偏向装置を説明する図２のＡ－Ａ線断面図である。
【図２】図１の平面図である。
【図３】本発明の第１の実施形態を示す光偏向装置の主要部の状態を説明する説明図である。
【図４】本発明の第１の実施形態を示す光偏向装置の主要部の他の状態を説明する説明図である。
【図５】本発明の第２の実施形態を示す光偏向装置の主要部を説明する図６のＢ－Ｂ線断面図である。
【図６】図５の平面図である。
【図７】本発明の第２の実施形態を示す光偏向装置の主要部を説明する説明図である。
【図８】図７の変形例の欠点を説明する図である。
【図９】本発明の第３の実施形態を示す光偏向装置の他の主要部を説明する図１０のＤ－Ｄ線断面図である。
【図１０】図９の平面図である。
【図１１】本発明の第３の実施形態を示す光偏向装置の主要部を説明する拡大斜視図である。
【図１２】本発明の第３の実施形態の変形例を示す光偏向装置の主要部を説明する拡大斜視図である。
【図１３】本発明の第４の実施形態を示す光偏向装置の主要部を説明する図１４のＥ－Ｅ

線断面図である。
【図１４】図１３の平面図である。
【図１５】本発明の第４の実施形態を示す光偏向装置の主要部を説明する拡大斜視図である。
【図１６】本発明の第４の実施形態の変形例を示す光偏向装置の主要部を説明する拡大斜視図である。
【図１７】本発明の第５の実施形態を示す光偏向装置の主要部を説明する図１８のＦ－Ｆ線断面図である。
【図１８】図１７の平面図である。
【図１９】本発明の第６の実施形態を示す光偏向装置の主要部を説明する図１４のＧ－Ｇ線断面図である。
【図２０】図１９の平面図である。
【図２１】本発明の第６の実施形態を示す光偏向装置の主要部を説明する拡大斜視図である。
【図２２】本発明の第６の実施形態の変形例を示す光偏向装置の主要部を説明する拡大斜視図である。
【図２３】本発明の第７の実施形態を示す光偏向装置の主要部を説明する図２４のＨ－Ｈ線断面図である。
【図２４】図２３の平面図である。
【図２５】本発明の第７の実施形態を示す光偏向装置の主要部を説明する図２６のＩ－Ｉ線断面図である。
【図２６】図２５の平面図である。
【図２７】本発明の第７の実施形態を示す光偏向装置の他の主要部を説明する平面図である。
【図２８】本発明の第７の実施形態を示す光偏向装置の他の主要部の動作を説明する図２７のＪ－Ｊ線断面図である。
【図２９】本発明の第７の実施形態を示す光偏向装置の他の主要部の他の動作を説明する図２７のＪ－Ｊ線断面図である。
【図３０】本発明の第７の実施形態を示す光偏向装置の他の主要部の他の動作を説明する図２７のＫ－Ｋ線断面図である。
【図３１】本発明の第７の実施形態を示す光偏向装置の他の主要部の他の動作を説明する図２７のＪ－Ｊ線断面図である。
【図３２】本発明の第７の実施形態を示す光偏向装置の他の主要部の他の動作を説明する図２７のＫ－Ｋ線断面図である。
【図３３】本発明の第７の実施形態を示す光偏向装置の他の主要部の他の動作を説明する図２７のＪ－Ｊ線断面図である。
【図３４】本発明の第７の実施形態を示す光偏向装置の他の主要部の他の動作を説明する図２７のＫ－Ｋ線断面図である。
【図３５】本発明の第７の実施形態を示す光偏向装置における静電力の発生を説明する図２７のＬ－Ｌ線断面図である。
【図３６】本発明の第８の実施形態を示す光偏向装置の主要部を説明する図３７のＰ－Ｐ線断面図である。
【図３７】図３６の平面図である。
【図３８】本発明の第９の実施形態を示す光偏向装置の主要部を説明する図３９のＱ－Ｑ線断面図である。
【図３９】図３８の平面図である。
【図４０】本発明の第１０の実施形態を示す光偏向装置の主要部を説明する図４１のＲ－Ｒ線断面図である。
【図４１】図４０の平面図である。
【図４２】本発明の第１１の実施形態を示す光偏向装置の主要部を説明する図４３のＳ－

S線断面図である。
【図４３】図４２の平面図である。
【図４４】本発明の第１１の実施形態を示す光偏向装置の主要部を説明する説明図である。
【図４５】本発明の第１２の実施形態を示す光偏向装置の主要部を説明する図４６のＴ－Ｔ線断面図である。
【図４６】図４５の平面図である。
【図４７】本発明の第１３の実施形態を示す光偏向装置の主要部を説明する図４８のＵ－Ｕ線断面図である。
【図４８】図４７の平面図である。
【図４９】本発明の第１４の実施形態を示す光偏向装置を説明する説明図である。
【図５０】本発明の第１５の実施形態を示す光偏向装置を説明する説明図である。
【図５１】本発明の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図５２】本発明の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図５３】本発明の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図５４】本発明の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図５５】本発明の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図５６】本発明の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図５７】本発明の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図５８】本発明の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図５９】本発明の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図６０】本発明の実施形態に示す光偏向装置の製造方法の他の主要部の工程を説明する説明図である。
【図６１】本発明の実施形態に示す光偏向装置の製造方法の他の主要部の工程を説明する説明図である。
【図６２】本発明の他の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図６３】本発明の他の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図６４】本発明の他の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図６５】本発明の他の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図６６】本発明の他の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図６７】本発明の他の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図６８】本発明の他の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図６９】本発明の他の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。

【図７０】本発明の他の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図７１】本発明の他の実施形態に示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図７２】本発明の更に他の実施形態を示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図７３】本発明の更に他の実施形態を示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図７４】本発明の更に他の実施形態を示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図７５】本発明の更に他の実施形態を示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図７６】本発明の更に他の実施形態を示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図７７】本発明の更に他の実施形態を示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図７８】本発明の更に他の実施形態を示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図７９】本発明の更に他の実施形態を示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図８０】本発明の更に他の実施形態を示す光偏向装置の製造方法の主要部の工程を説明する説明図である。
【図８１】本発明の実施形態に示す光偏向装置を具備する画像形成装置を説明する説明図である。
【図８２】本発明の実施形態に示す光偏向装置を具備する画像投影表示装置を説明する説明図である。
【図８３】本発明の実施形態に示す光偏向装置を具備する光伝送装置を説明する説明図である。
【図８４】本発明の第１６の実施形態を示す光偏向装置の主要部を説明するための平面図である。
【図８５】図８４のＡ－Ａ' 線断面図である。
【図８６】本発明の第１７の実施形態を示す光偏向装置の主要部を説明するための平面図である。
【図８７】図８６のＡ－Ａ' 線断面図である。
【図８８】本発明の第１８の実施形態を示す光偏向装置の主要部を説明するための平面図である。
【図８９】本発明の第１９の実施形態を示す光偏向装置の主要部を説明するための平面図である。
【図９０】図８９のＡ－Ａ' 線断面図である。
【図９１】本発明の第２０の実施形態を説明する図である。
【図９２】本発明の第２１の実施形態を説明する図である。
【図９３】本発明の第２２の実施形態を説明する図である。
【図９４】本発明の第２３の実施形態を説明する図である。
【図９５】第２３の実施形態に適用する支点部材の変形例を示す図である。
【図９６】本発明の第２４の実施形態を説明する図である。
【図９７】本発明の第２５の実施形態をを説明する図である。
【図９８】本発明の第２６の実施形態をを説明する図である。
【図９９】図９８における光偏向装置２１００の、リセット動作時のＤ－Ｄ' 線の断面図である。
【図１００】本発明の第２７の実施形態を説明する図である。

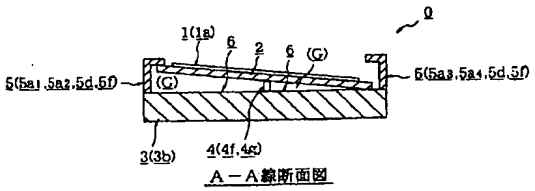
【図１０１】本発明の第２８の実施形態を説明する図である。
【図１０２】本発明の第２９の実施形態を説明する図である。
【図１０３】本発明の光偏向アレー１２００を、画像投影表示装置に適用した例を説明する図である。
【図１０４】本発明の光偏向アレー１２００を複写機等の画像形成装置に適用した例を示す図である。
【図１０５】本発明の光偏向アレー１２００を光伝送装置に適用した例を示す図である。
【図１０６】本発明の光偏向装置２１００または光偏向アレー１２００の製造工程を示す図である。
【図１０７】第２４の実施例の斜面の凸部位を形成する工程を示す図である。
【図１０８】支点部材の形状について説明するための図である。
【図１０９】支点部材の形状について説明するための図である。
【図１１０】本発明の第２５実施形態における凸部位に対する、変形実施形態を示す図である。
【図１１１】本発明の第２５実施形態における凸部位に対する、変形実施形態を示す図である。
【図１１２】規制部材の実施形態を示す図である。
【図１１３】規制部材の変形実施形態を説明するための斜視図である。
【図１１４】変形実施形態の規制部材を用いた光偏向装置の断面図である。
【図１１５】規制部材の更なる変形実施形態を示す斜視図である。
【図１１６】変形実施形態の規制部材の使用例を示す断面図である。
【図１１７】変形実施形態の規制部材の使用例を示す断面図である。
【図１１８】本発明の他の実施形態に係わる光偏向装置の製造手順を示す図である。
【図１１９】本発明の他の実施形態に係わる光偏向装置の製造手順を示す図である。
【図１２０】本発明の他の実施形態に係わる光偏向装置の製造手順を示す図である。
【図１２１】本発明の他の実施形態に係わる光偏向装置の製造手順を示す図である。
【図１２２】本発明の他の実施形態に係わる光偏向装置の製造手順を示す図である。
【図１２３】本発明の他の実施形態に係わる光偏向装置の製造手順を示す図である。
【図１２４】本発明の他の実施形態に係わる光偏向装置の製造手順を示す図である。
【図１２５】本発明の他の実施形態に係わる光偏向装置の製造手順を示す図である。
【図１２６】本発明の他の実施形態に係わる光偏向装置の製造手順を示す図である。
【図１２７】本発明の他の実施形態に係わる光偏向装置の製造手順を示す図である。
【符号の説明】
０　光偏向装置
１　反射手段
１ａ　反射面
１ｂ　アルミニウム系金属膜
２　板形状部材
２ａ　湾曲形状部
２ｂ　導電性領域
２ｃ　シリコン窒化膜
２ｄ　接触部
３　基板
３ａ　窪み形状部
３ｂ　（１００）面方位を有するシリコン基板
３ｃ　絶縁膜
４　支点部材
４ａ　円形状部
４ａ１　円柱形状
４ｂ　円錐形状部

4 b_1 点形状
4 b_2 丸形状
4 c 長方形状部
4 d, 4 d_1, 4 d_2, 4 d_3, 4 d_4 斜面
4 e 尾根形状部
4 e_1 線形状
4 e_2 丸形状
4 f 酸化シリコン膜
4 g シリコン窒化膜
5 笠形状部材
5 a_1～n 笠形状部材
5 b 絶縁膜
5 c 透光性膜
5 d 酸化シリコン膜
5 e 遮光性膜
5 f 酸化クロム膜
6, 6 a_1, 6 a_2, 6 a_3, 6 a_4 電極
6 b 保護膜
7 犠牲層
7 a 第１の犠牲層
7 b 第２の犠牲層
7 c 第３の犠牲層
１０ １次元光偏向アレー
２０, ２０a, ２０b ２次元光偏向アレー
１００ 光情報処理装置
１０１ 独立駆動手段
１０２ 光源
１０３ 第１のレンズシステム
１０４ 第２のレンズシステム
１０５ 投影レンズ
１０６ 絞り
１０７ 回転カラーホール
１０８ マイクロレンズアレー
２００ 画像形成装置
２０１ 画像担持体
２０２ 潜像形成手段
２０３ 現像手段
２０４ 転写手段
２０５ 帯電手段
２０６ 定着手段
２０７ 排紙トレイ
２０８ クリーニング手段
３００ 画像投影表示装置
３０１ 光スイッチ手段
３０２ 投影スクリーン
４００ 光伝送装置
４０１ 光信号入力手段
４０１a, ４０１a_1, ４０１a_2 信号入力伝達ポート
４０２ 光スイッチ手段
４０２a, ４０２a_1 制御装置

４０３　光信号出力手段
４０３ａ．４０３ａ$_1$．４０３ａ$_2$　信号出力伝達ポート
（ａ$_1$）　基板上支点部材形成工程
（ａ$_2$）　電極形成工程
（ａ$_3$）　保護膜形成工程
（ａ$_4$）　第１の犠牲層形成工程
（ａ$_5$）　反射手段と板形状部材形成工程
（ａ$_6$）　第２の犠牲層形成工程
（ａ$_7$）　笠形状部材パターン化工程
（ａ$_8$）　笠形状部材形成工程
（ａ$_9$）　犠牲層除去工程
（ｂ$_1$）　基板上支点部材形成工程
（ｂ$_2$）　電極形成工程
（ｂ$_3$）　保護膜形成工程
（ｂ$_4$）　第１の犠牲層形成工程
（ｂ$_5$）　第３の犠牲層形成工程
（ｂ$_6$）　反射手段と板形状部材形成工程
（ｂ$_7$）　第２の犠牲層形成工程
（ｂ$_8$）　笠形状部材パターン化工程
（ｂ$_9$）　笠形状部材形成工程
（ｂ$_{10}$）　犠牲層除去工程
（ｃ$_1$）　基板上窪み形状部と支点部材形成工程
（ｃ$_2$）　電極形成工程
（ｃ$_3$）　保護膜形成工程
（ｃ$_4$）　第１の犠牲層形成工程
（ｃ$_5$）　反射手段と板形状部材形成工程
（ｃ$_6$）　第２の犠牲層形成工程
（ｃ$_7$）　笠形状部材パターン化工程
（ｃ$_8$）　笠形状部材形成工程
（ｃ$_9$）　犠牲層除去工程
６０１　支点部材
６０２　導電部材
６０３　絶縁性膜
７０１　凸部位
８００　電極
８０１　絶縁層
８０２　導電層
１２００　光偏向アレー
１３００　画像投影表示装置
１３０１　光スイッチ手段
１４００　画像形成装置
１４０２　潜像形成手段
１５００　光伝送装置
１５０２　光信号入力部
１５０３　１段目の光偏向アレー
１５０５　２段目の光偏向アレー
１５０７　光信号出力部
２１００　光偏向装置
２１０１　基板
２１０２　規制部材

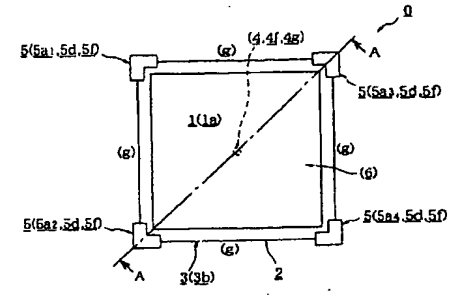
2103	支点部材
2104	板状部材
2201	誘電体層
2202	導電体層
2301	電極
2401	支点部材
2402	接触部位

【図１】

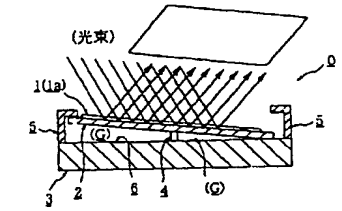


A－A線断面図

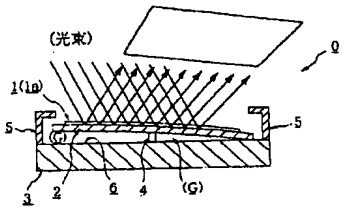
【図２】



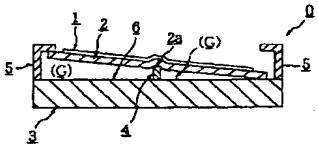
【図３】



【図４】

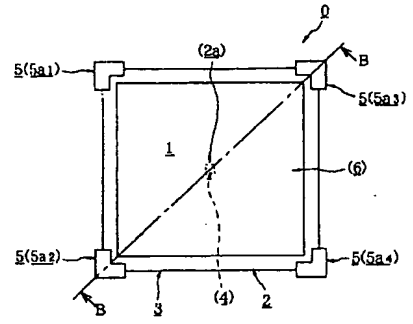


【図５】

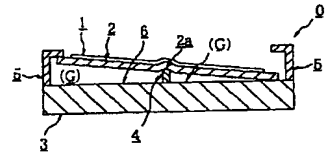


B－B線断面図

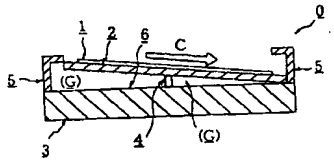
【図６】



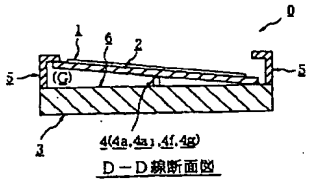
【図７】



【図８】

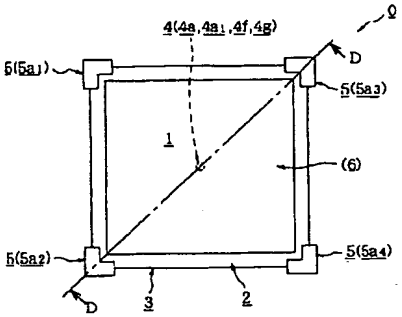


【図９】

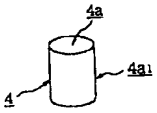


D－D線断面図

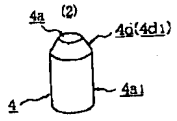
【図１０】



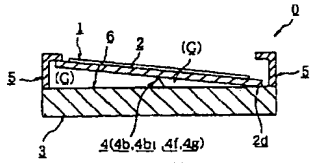
【図１１】



【図１２】

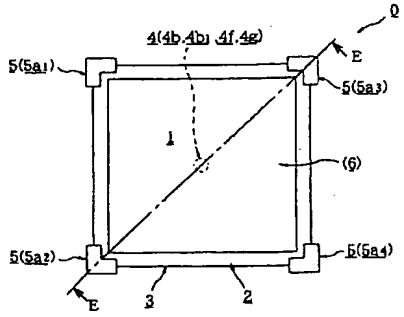


【図１３】

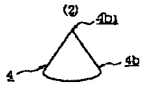


E－E線断面図

【図１４】

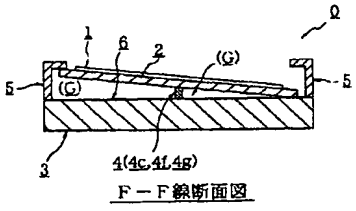


【図１５】



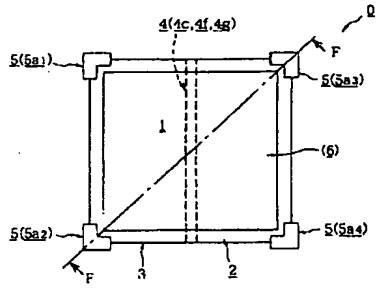
【図１６】

【図１７】

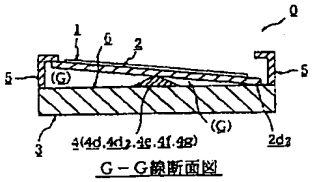


F－F線断面図

【図１８】

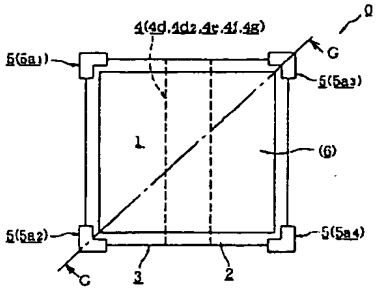


【図１９】

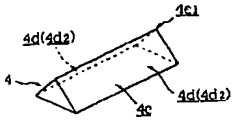


G－G線断面図

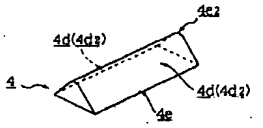
【図２０】



【図２１】



【図２２】



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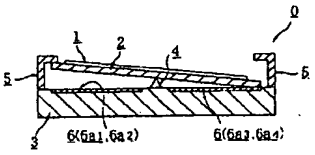
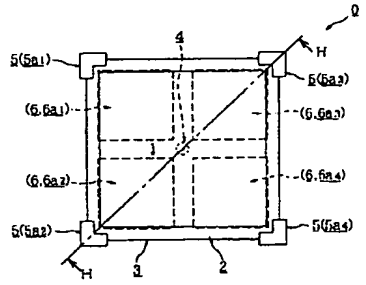
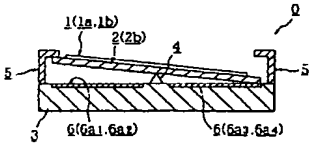


H－H線断面図

【図２４】

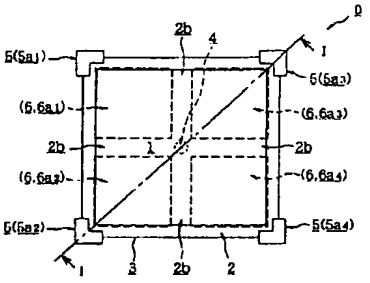


【図２５】



I－I線断面図

【図２６】



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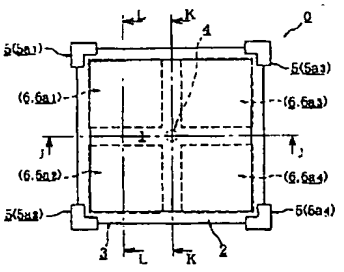

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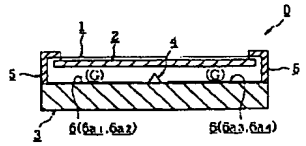
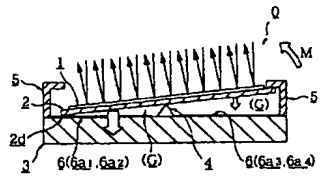


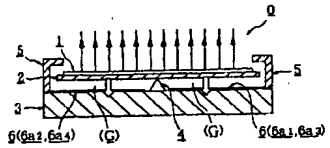
Ｊ－Ｊ線断面図

【図２９】



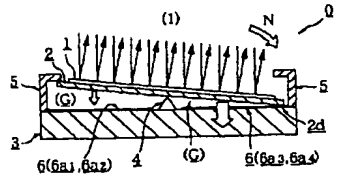
Ｊ－Ｊ線断面図

【図３０】



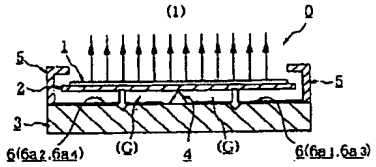
Ｋ－Ｋ線断面図

【図３１】



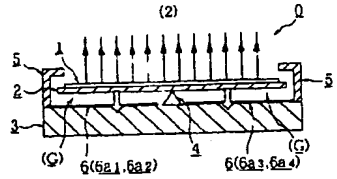
Ｊ－Ｊ線断面図

【図３２】



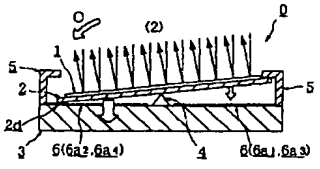
Ｋ－Ｋ線断面図

【図３３】



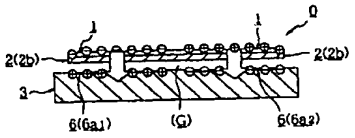
Ｊ－Ｊ線断面図

【図３４】



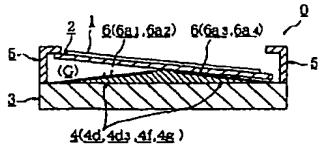
Ｋ－Ｋ線断面図

【図３５】



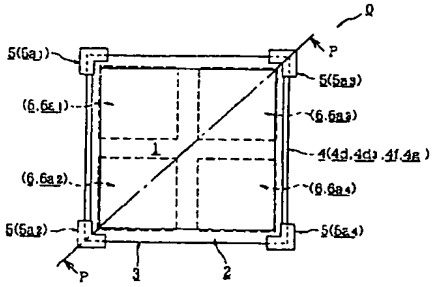
Ｌ－Ｌ線断面図

【図３６】

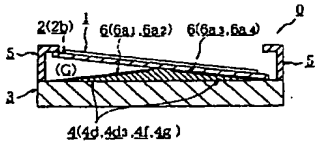


Ｐ－Ｐ線断面図

【図３７】

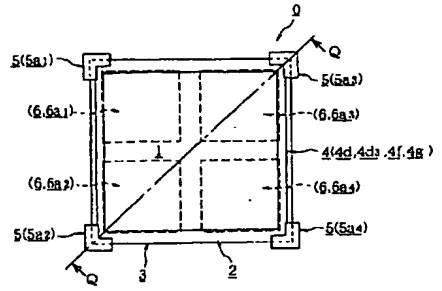


【図３８】

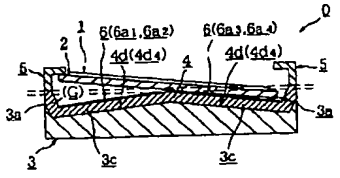


Ｑ－Ｑ線断面図

【図３９】

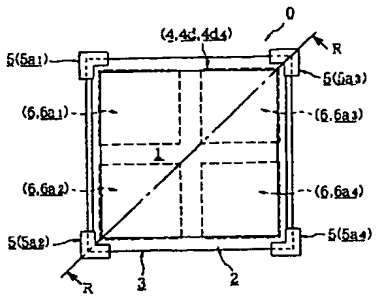


【図４０】

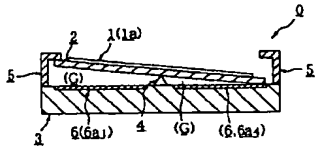


R－R線断面図

【図４１】

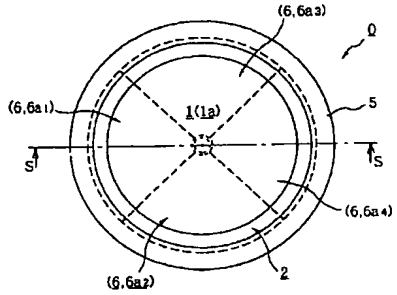


【図４２】

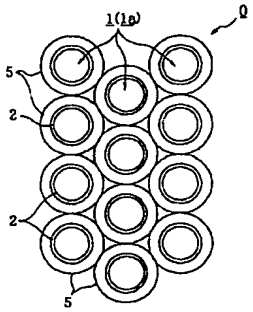


S－S線断面図

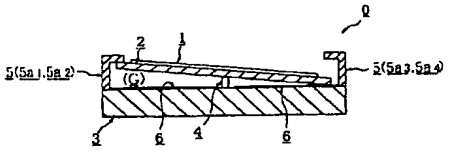
【図４３】



【図４４】

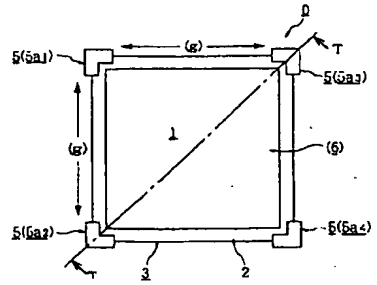


【図４５】

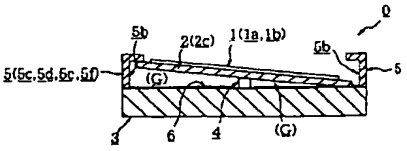


T－T線断面図

【図４６】

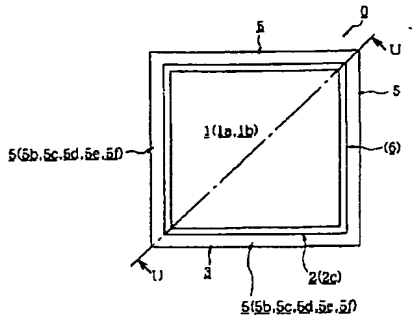


【図４７】

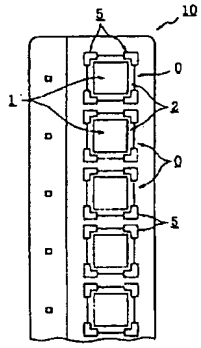


U－U線断面図

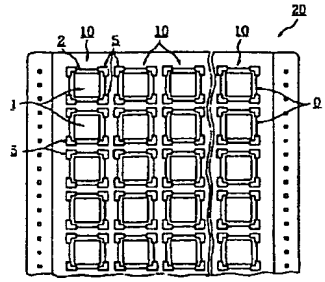
【図４８】



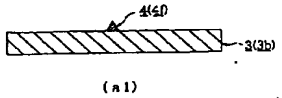
【図４９】



【図５０】



【図５１】

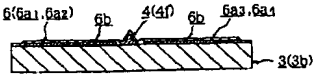


(a1)

【図５２】

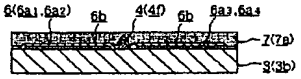
(a2)

【図５３】



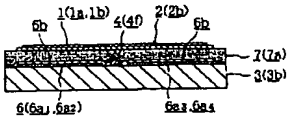
(a3)

【図５４】



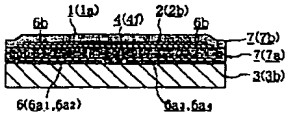
(a4)

【図５５】



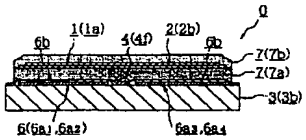
(a5)

【図５６】



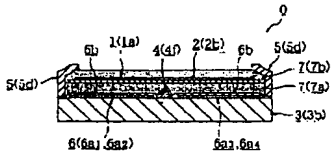
(a6)

【図５７】



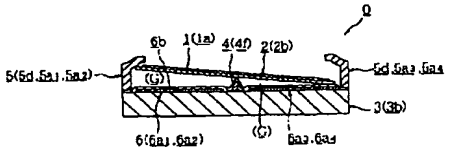
(a7)

【図５８】



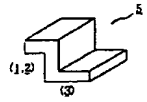
(a8)

【図５９】

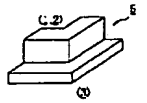


(a9)

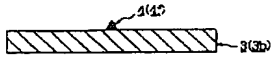
【図６０】



【図６１】

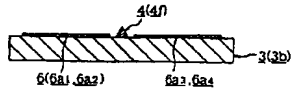


【図６２】



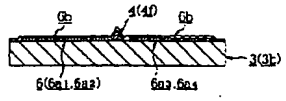
(b1)

【図６３】



(b2)

【図６４】



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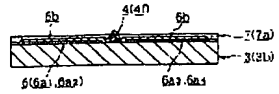

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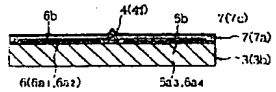

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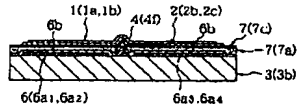

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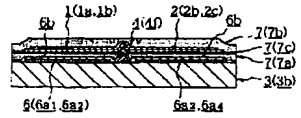

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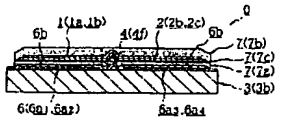

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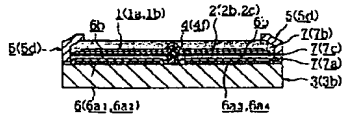

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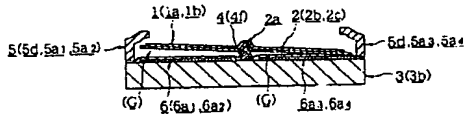

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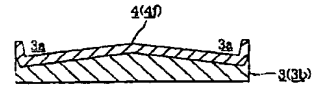

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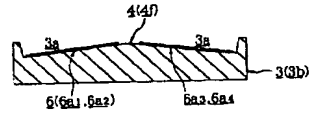

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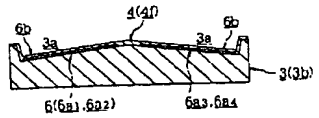

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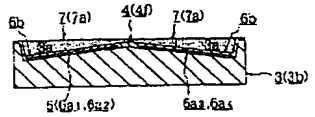

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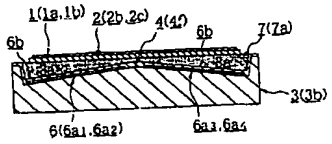

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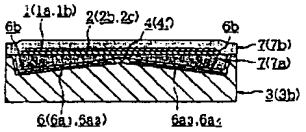

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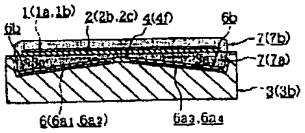

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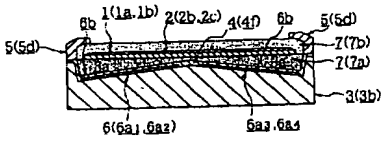

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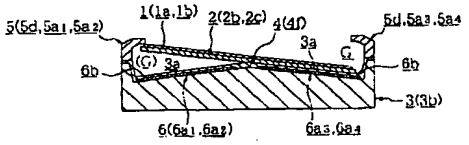

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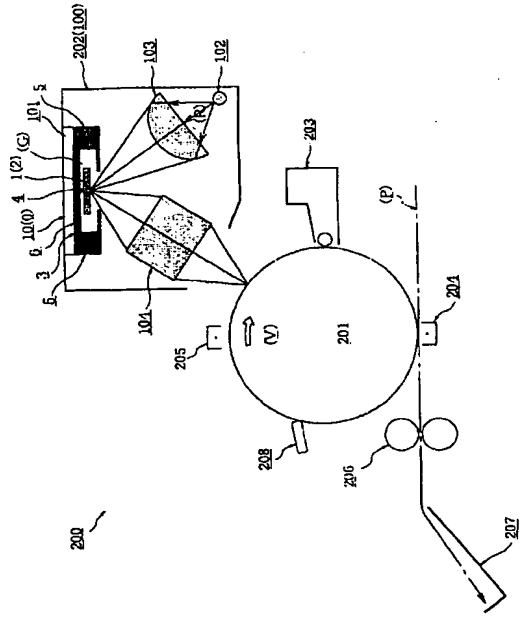

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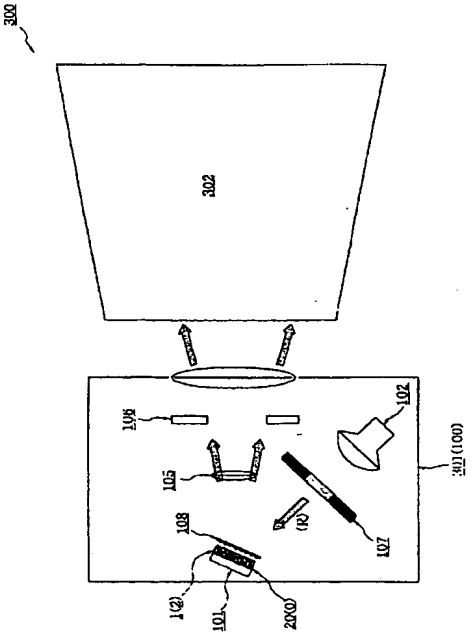

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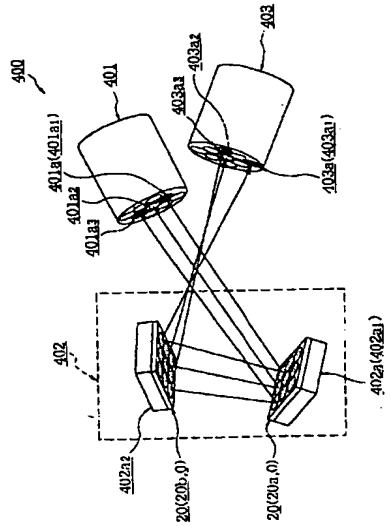

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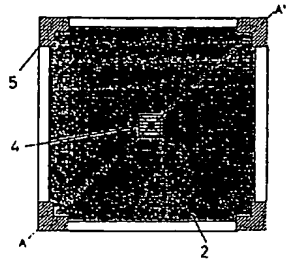

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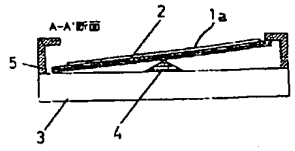

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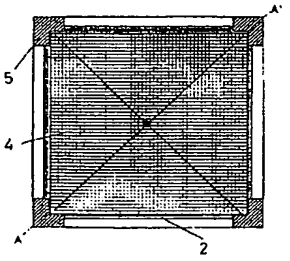

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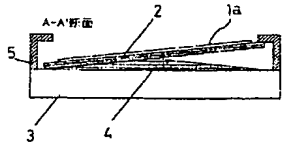

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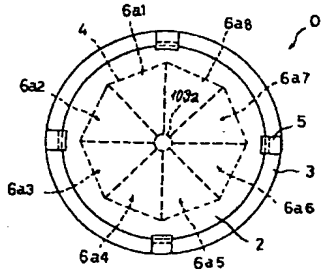

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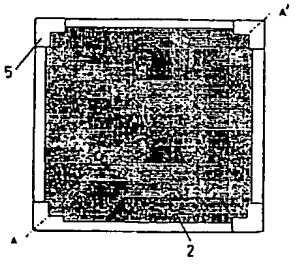

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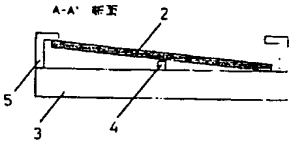

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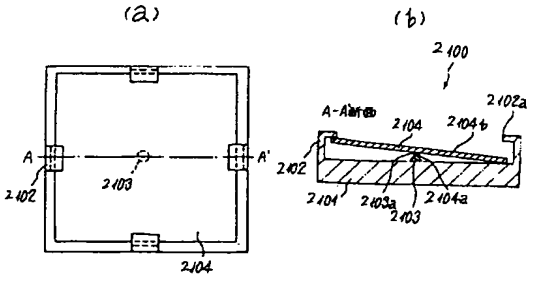

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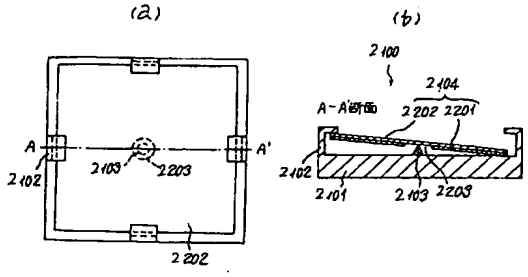

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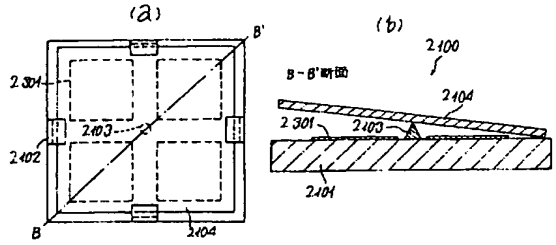

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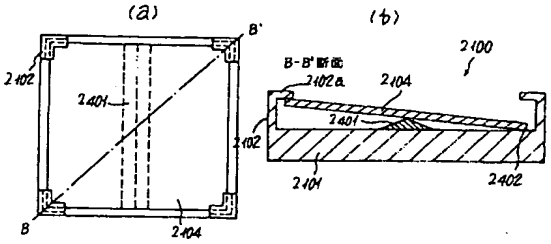

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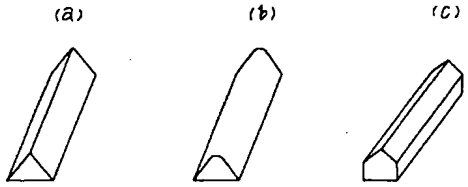

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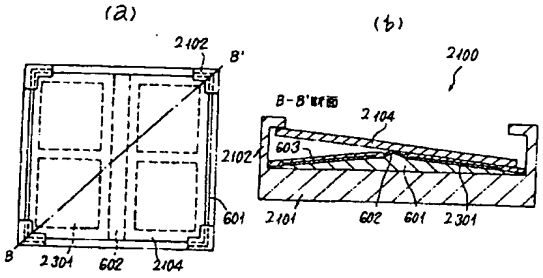

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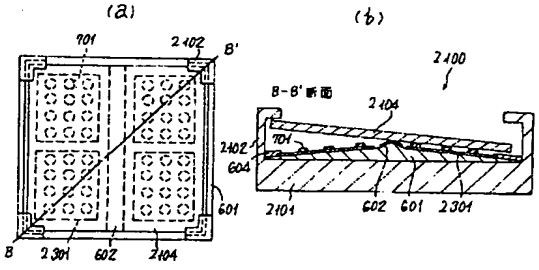

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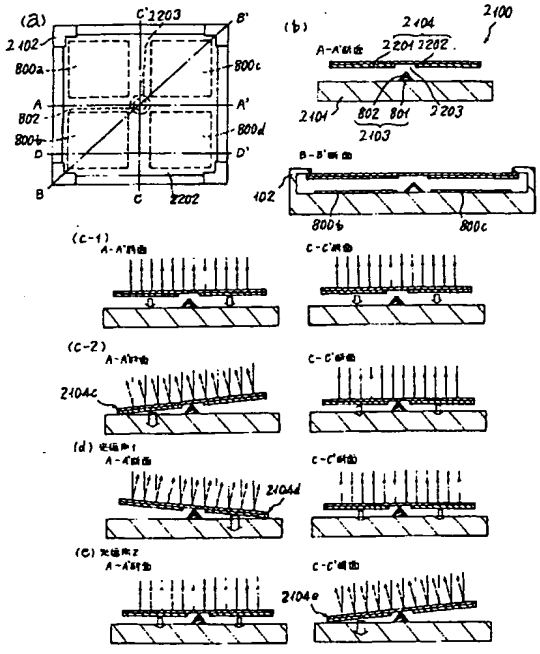

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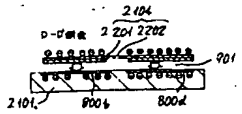

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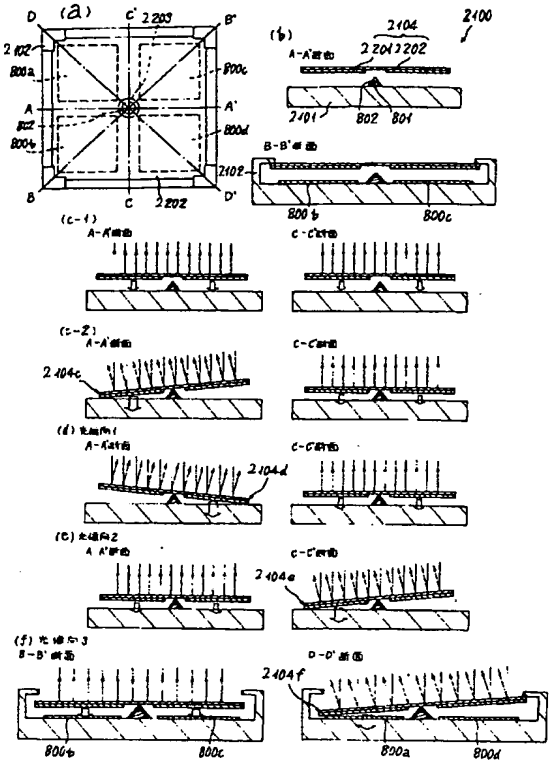

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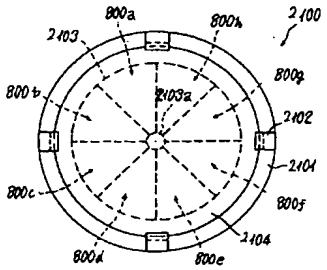

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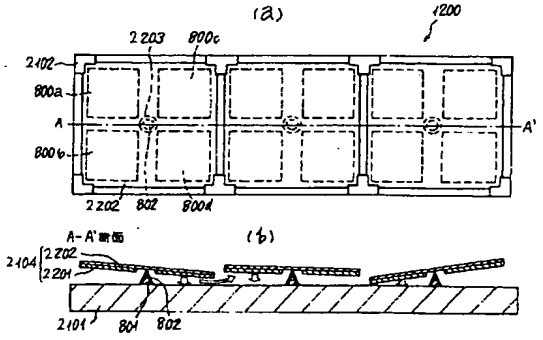

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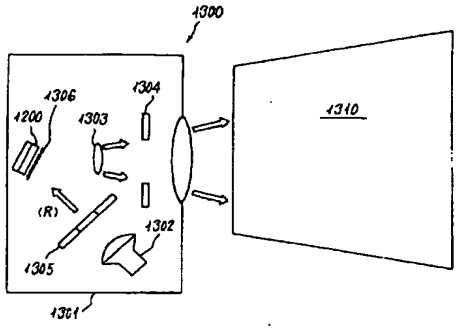

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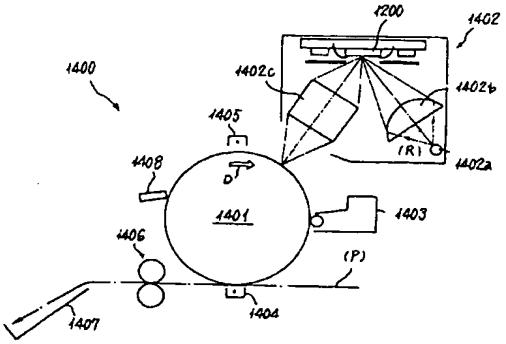

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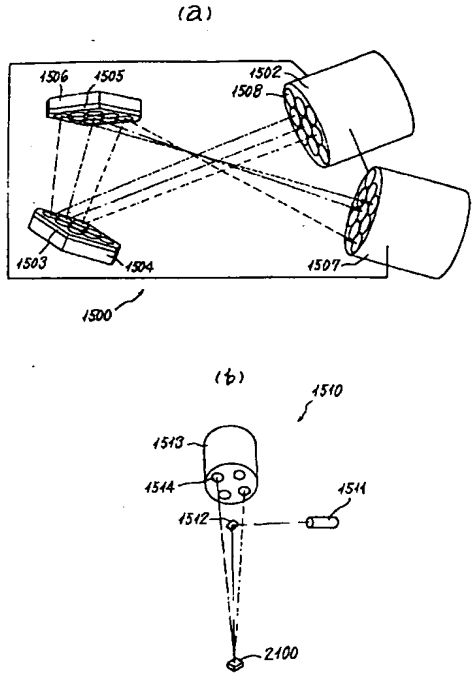

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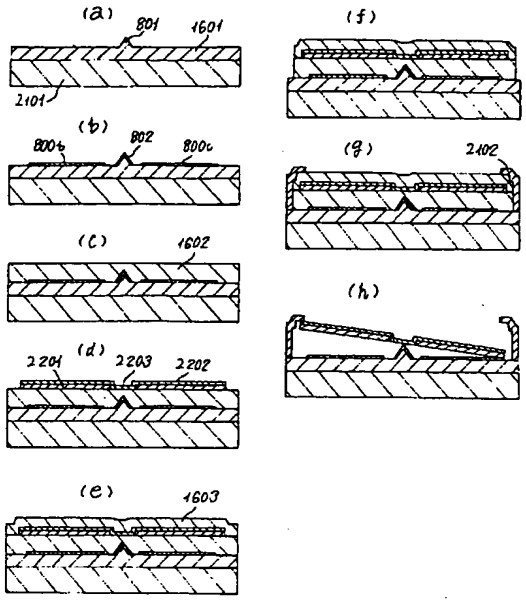

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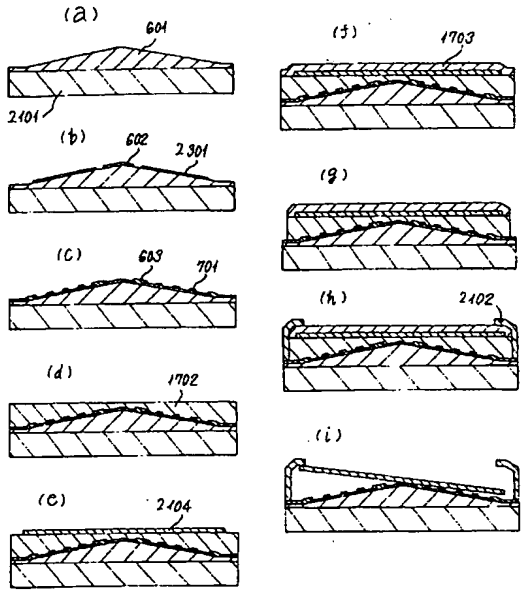

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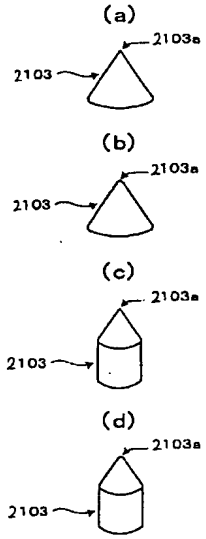

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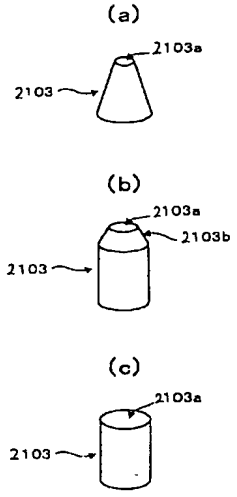

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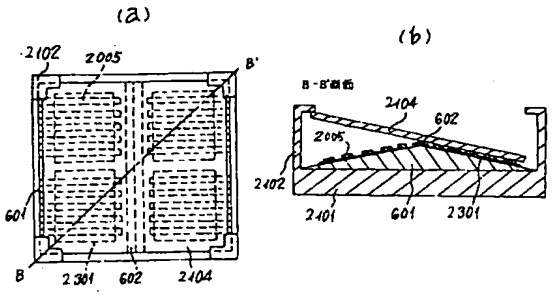

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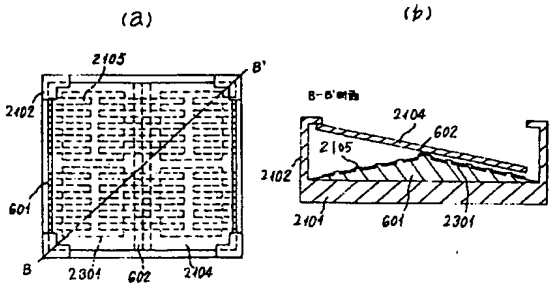

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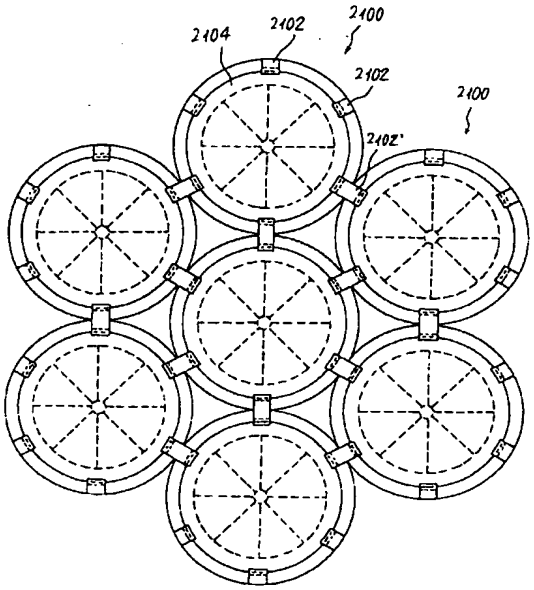

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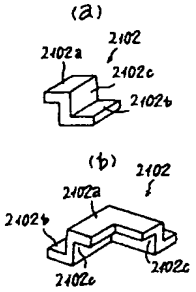

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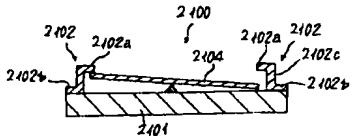

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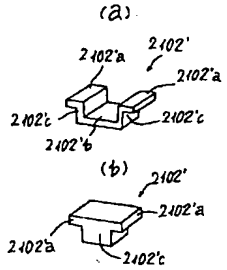

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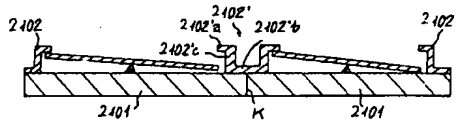

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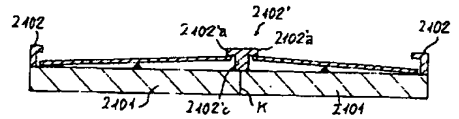

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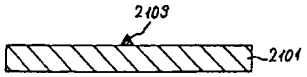

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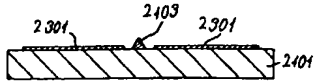

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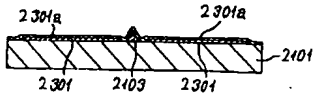

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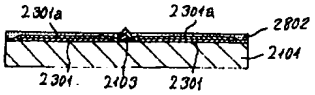

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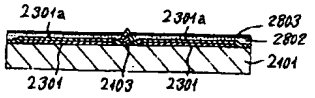

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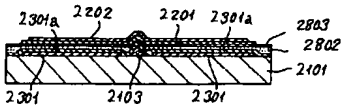

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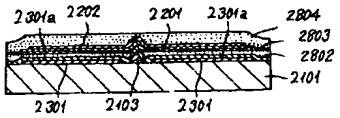

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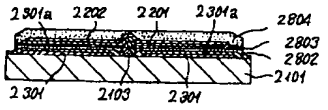

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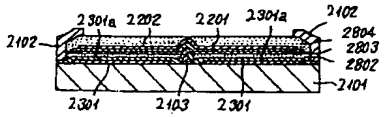

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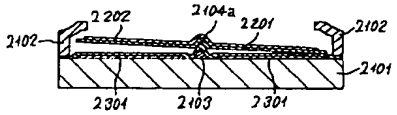

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